KU LEUVEN

Faculty of Psychology and Educational Sciences
Centre for Instructional Psychology and Technology

Determinants of Instructors' Educational ICT Use in Higher Education in Developing Countries

Evidence from Ethiopian Higher Education

Bekalu Ferede Tefera



Doctoral thesis offered to obtain the degree of
Doctor of Educational Sciences (PhD) from KU Leuven and
PhD in Education (Curriculum and Instruction) from Jimma University

Promoter: Prof. Dr. Katie Goeman
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Promoters: Prof. Dr. Katie Goeman, Prof. Dr. Jan Elen, Prof. Dr. Wim Van Petegem and Prof. Dr. Adula Bekele Hunde

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Higher Education (HE) in developing countries experiences problem with equity, access and quality. Although the use of information and communication technologies (ICT) is not a panacea for all difficulties in HE, it may address some of the challenges in developing countries like Ethiopia. It may, among other things, facilitate the implementation of teaching approaches that promote students' engagement, collaboration and interaction, as well as create unrestricted access to teaching and learning resources. Despite the potential benefits of ICT, however, it remains underutilized in HE in developing countries. Moreover, there is a lack of studies explaining what factors determine ICT use while taking into account the specific context of HE in developing countries. Hence, by taking Ethiopia as a showcase, this research project aims to yield a generic and parsimonious model regarding ICT use for educational purposes in developing countries.

In particular, this Ph.D. intends to answer the central question: "What factors determine HE instructors' educational use of ICT in Ethiopia?" It puts forward three specific research questions (1) How, why and to what extent do HE instructors in Ethiopia use ICT for educational purposes?, (2) What factors are identified by HE instructors in Ethiopia as determinants of their ICT use?, and (3) Which factors predict HE instructors' educational use of ICT in Ethiopia and how do they interrelate? To do this, the Ph.D. study integrates two successive phases, a qualitative and a quantitative research approach. The first and second research questions are tackled by means of a literature review and an exploratory qualitative study. Following on from a conceptual model built upon existing theory and empirical claims, the different model components are scrutinized in detail by means of thematic analysis, and an adjusted model is presented. The evidence is based on focus group data collected among twenty-one Ethiopian HE instructors. The follow-up quantitative investigation tests the relevance of the adjusted model, in particular the relationships between instructors‟ ICT use and its determining factors. The evidence is based on survey data collected among 946 HE instructors from six Ethiopian universities. Structural equation modeling analysis is applied in order to assess fourteen hypotheses.

In brief, the results do not reveal a transformative use of ICT among HE instructors; they use ICT mainly to re-package existing teaching practices. The results also show that the institutional context (vision and plan, support, professional development and infrastructure) and individual characteristics (attitudes and competences) are the main influences behind HE instructors' ICT use. Moreover, the study identifies aspects of access, management support, the nature of a course, students' ICT competences as determinants of HE instructors' use of ICT. ICT competence and ICT attitude are identified as the sole determinants with a direct positive influence on HE instructors' ICT use.

Instructors‟ ICT competence and attitude only explain 35% of the variation in their ICT use. Though the model (with 35% explanatory power) can be considered satisfactory, the need for further investigation of a holistic kind with a more powerful model is crystal clear. Hence, based on the findings of prior studies and further review of the literature, an integrative ICT integration model (the I3) is proposed. The proposed model has both empirical and conceptual components and consists of determinants in six categories, namely: institution, instructor, student, technology, culture and academic discipline.

Finally, the findings of the three studies and the proposed I3 model are discussed. Also, implications (practice and theory) and limitations of the study as well as the avenues of future studies are discussed.

Bekalu Ferede Tefera

Bepalende factoren voor onderwijskundig ICT-gebruik door docenten in ontwikkelingslanden: Onderzoek in het Ethiopische hoger onderwijs

Proefschrift ingediend ter behalen van de graad van Doctor in de Onderwijskunde, 2022

Promotoren: Prof. Dr. Katie Goeman, Prof. Dr. Jan Elen, Prof. Dr. Wim Van Petegem en Prof. Dr. Adula Bekele Hunde

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Het hoger onderwijs (HO) in ontwikkelingslanden kampt met een gelijkheid, toegang en kwaliteitsprobleem. Hoewel het gebruik van informatie- en communicatietechnologieën (ICT) geen „wonder oplossing" biedt voor alle problemen in het hoger onderwijs, kan het een aantal van de uitdagingen in ontwikkelingslanden -zoals Ethiopië- aanpakken. ICT kan, onder andere, de implementatie van onderwijsmethoden vergemakkelijken die de betrokkenheid, samenwerking en interactie van studenten bevorderen, en kan tevens onbeperkte toegang tot onderwijs- en leermiddelen creëren. Ondanks de potentiële voordelen van ICT wordt er in het HO in ontwikkelingslanden nog te weinig gebruik van gemaakt. Bovendien is er een gebrek aan studies die verklaren welke factoren het ICT-gebruik bepalen, rekening houdend met de specifieke context van het HO in ontwikkelingslanden. Door Ethiopië als voorbeeld te nemen, heeft dit onderzoeksproject als doel een op maat gemaakt en beknopt model aan te leveren met betrekking tot ICT- gebruik voor onderwijsdoeleinden in ontwikkelingslanden.

In het bijzonder wil dit doctoraat een antwoord bieden op de centrale vraag: "Welke factoren bepalen het onderwijskundig ICT-gebruik van docenten in het HO in Ethiopië?" Er worden drie specifieke onderzoeksvragen gesteld: (1) Hoe, waarom en in welke mate maken docenten in het HO in Ethiopië gebruik van ICT voor onderwijsdoeleinden?, (2) Welke factoren worden door docenten in het HO in Ethiopië geïdentificeerd als bepalende factoren voor hun ICT-gebruik?, en (3) Welke factoren voorspellen het ICT- gebruik van docenten in het HO in Ethiopië en hoe hangen ze met elkaar samen? Om deze vragen te onderzoeken, integreert dit doctoraat twee opeenvolgende fasen: een kwalitatieve en een kwantitatieve onderzoeksaanpak. De eerste en tweede onderzoeksvraag worden nagegaan door middel van een literatuuronderzoek en een verkennend kwalitatief onderzoek. Verschillende modelcomponenten van een conceptueel model (gebaseerd op bestaande theorie en empirische claims) worden in detail onderzocht door middel van thematische analyse. Een aangepast model wordt hierbij gepresenteerd. De onderzoeksdata is gebaseerd op focusgroep interviews met Ethiopische docenten in het HO (n = 21). Het kwantitatieve vervolgonderzoek gaat de relevantie van het aangepaste model na, in het bijzonder de relaties tussen het ICT- gebruik van docenten en de bepalende factoren. Onderzoeksdata is verzameld aan de hand van vragenlijstonderzoek bij 946 docenten in het HO van zes Ethiopische universiteiten. Structurele vergelijkingsmodelanalyse is toegepast om veertien hypothesen te toetsen.

Kort samengevat blijkt uit de resultaten niet dat docenten in het HO op een transformatieve manier gebruik maken van ICT; ze gebruiken ICT vooral bestaande onderwijspraktijken. De resultaten tonen ook aan dat de belangrijkste invloeden op het ICT-gebruik van docenten in het HO de institutionele context (visie en plan, ondersteuning, professionele ontwikkeling en infrastructuur) en individuele kenmerken (attitudes en competenties) zijn. Bovendien identificeert de studie aspecten van toegang, managementondersteuning, de aard van een vak, de ICT-competenties van studenten als bepalende factoren voor het ICT-gebruik van docenten in het HO. ICT-competentie en ICT-attitude worden geïdentificeerd als de grootste bepalende factoren, met een directe positieve invloed op het ICT-gebruik van docenten in het HO. De ICT-competentie en -attitude van docenten verklaren slechts 35% van de variatie in hun ICT- gebruik. Hoewel het model (met 35% verklaringskracht) als voldoende kan worden beschouwd, is er zeker nood aan verder onderzoek van een holistische aard met een krachtiger model. Daarom wordt, op basis van de bevindingen van eerdere studies en verdere literatuurstudie, een integratief ICT-integratiemodel (het I3) voorgesteld. Het voorgestelde model heeft zowel empirische als conceptuele componenten en bestaat uit determinanten in zes categorieën, namelijk: instelling, docent, student, technologie, cultuur en academische discipline.

Ten slotte worden de bevindingen van de drie studies en het voorgestelde I3-model besproken. Ook worden de implicaties (praktijk en theorie) en beperkingen van de studie besproken, evenals de mogelijkheden voor toekomstige studies.

Dedication

To my father, the late Ferede Tefera and my mother the “illitrate professor” Desta Lamu

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Chapter One: General Introduction

Scholars in the field of technology in general and educational technology in particular have dedicated their studies to develop models and theories that inform ICT use practices in (higher) education. However, the available theories and models neglect the peculiar context of higher education (HE) in developing countries. Hence, further scrutiny is necessary to develop a model that explains instructors' ICT use in HE in developing countries. This Ph.D. research is, therefore, devoted to propose a parsimonious and at the same time generic model of instructors' ICT use in the context of HE in developing countries based on evidence generated from Ethiopian HE context as well as available literature.

1. Setting the research agenda

Human life, whether in a developed or a developing country, is influenced by the unceasing advancement of information and communication technologies (ICTs). ICT for development (ICT4D) projects support different sectors such as Agriculture, Health, Business, Manufacturing and Tourism in order to digitalize their services and operations based on the belief that ICT has the potential to transform their efficiency and performance. Similarly, the Agenda 2063 (a shared framework for inclusive growth and sustainable development for Africa) (African Union Comission, 2015) and the Digital Ethiopia 2025 (a digital strategy for Ethiopia inclusive prosperity) (FDRE, n.d.), highlight the crucial role of ICT in realizing development in all sectors including HE. As within other sectors, HE institutions have become more dependent on ICT-supported activities to provide quality services (Alharthi et al., 2017). HE institutions are compelled to adopt ICTs in response to meeting the diversified needs of governments, students and employers. Continuous pressure from students for the need of flexible, quality and cost-effective education coupled with competitive educational environment make ICT use not a matter of choice in HE (Alharthi et al., 2017; El Alfy, Gómez & Ivanov, 2017). In addition to diversified needs of the stakeholders, internationalization, massification, and diversification of HE derived by political, economic and social changes have forced HE to consider ICT as critical tool to address these demands. Furthermore, it is a recent global development that the COVID-19 crisis has proved that ICT is unequalled solution to create a resilient HE that survives during catastrophes.

Though not a subject of this study, whether or not ICT has an impact on learning has been a point of debate since Clark's first publication regarding the impact of media on learning (see Clark, 1983). Based on review of studies on the impact of media on learning, Clark concluded that there are no learning benefits gained from using media in teaching and

learning (Clark, 1983). Clark further argued that, the role of media is no more than being a vehicle and it is the teaching method that has the most influence on learning (Clark, 1983; Clark & Clark, 1994). About a decade after Clark's publication, Kozma countered Clark stating that, media is more than a vehicle for delivery of learning content (Kozma, 1991). Kozma claimed that both media and method have an integral relationship and using correct media could influence learning through its impact on instructional deign (Kozma, 1991; Kozma, 1994). Since then, the Clark-Kozma "media effects" debate has continued to be an issue in media effect researches and is still on the table of ICT in education researchers with no winner over the battle. Higgins, Xiao and Katsipataki (2012), in their synthesis of the evidence from meta-analysis about the impact of the use of digital technology in schools on children's attainment, concluded that, in general studies over the last forty years show that technology has a positive outcome on learning. In a similar vein, other studies also indicate the positive impact of ICT on students learning and achievement (e.g., Means, Toyama, Murphy, Bakia, & Jones, 2009, Safar, 2015), students critical thinking skill, self-learning and satisfaction (e.g., Khan & Setiawan, 2019). Contrary to this, there are also studies that report ICT has a very little (e.g., Eng, 2005) or negligible impact (e.g., OECD, 2015; Talukder, Alam, & Apu, 2015) on learning outcomes. This variation on the findings of previous studies may be related to the research method they employed (including instrumentation) and aspects of ICT impact they studied (some may focus on academic achievement in test score an others may focus on such as areas as critical thinking, engagement and interaction among students). Surely, ICT could not be a panacea for every challenge HE faces. However, regardless of the ongoing debate as to the extent to which media influences learning, ICT has a potential to address some of the educational issues (e.g., quality, equity and access) of HE in developing countries[1] (James & Hopkinson, 2009). Ethiopia as one of the developing countries in the horn of Africa could address its HE issues by integrating ICT.

2. The Ethiopian HE and ICT use context at a glance

Ethiopia is the second-largest and most populous African country located on the horn of Africa. HE is only seven decades old in Ethiopia. HE began in 1950 with the establishment

[1] The terms "developed" or "developing" countries in the context of this study mainly relates to variations in the level of economic development between countries. In this sense, developing countries refer to "those countries that are economically underdeveloped" (Perkins, 2003). Developing countries are not

of the University College of Addis Ababa (UCAA) (Semela, 2011). HE in Ethiopia shares numerous ICT use issues with HE in other developing countries. As with other developing countries, ICT is lately introduced into Ethiopian HE (Alemu, 2017; Bekele, 2001). The Ethiopian government has embarked on ICT-enabled transformation in all sectors including education to enhance performance and deliver better public service with the ultimate goal of improving the lives of its citizens (Lixi & Dahan, 2014). In its fifth Education Sector Development Program (ESDP V) 2015/2016-2019/2020, the government expressed its commitment to the expansion of ICT and its integration to transform the quality of teaching at all levels of education. In the document, it is described that during the implementation period of ESDP V, ICT and internet connection will be provided to all universities, an ICT in education policy will be ratified, pedagogy, technology and content will be integrated, ICT will be mainstream across core subjects at all levels, digital contents will be developed, and a Learning Management System (LMS) will be in place to support the teaching and learning activities (MOE, 2016). In the Ethiopian education sector development roadmap, it is stated that HE needs to train graduates with the required employability skills such as critical thinking, creativity, problem solving and ICT skills (MOE, 2017). More specifically, the digital skills country action plan of HE and technical and vocational education and training highlights the crucial role of ICT enhanced teaching and learning in transforming the landscape of HE (MOSHE, 2020). In the plan, developing enabling policies, reforming digital skills programs to assess and empower HE leaders, instructors and students and providing the HE with high-speed internet and computers are identified as some of the key strategies to ensure ICT enabled education in the HE (MOSHE, 2020). With the assumption that the use of ICT is a key tool to address these multifaceted problems of HE, the government not only highlighted the need to transform the HE campus environment via ICT but also engaged in increased investments in ICT.

Despite several ICT initiatives, there are a number of challenges to the use of ICT in Ethiopian HE. A shred of very limited research evidence indicates that, like other developing countries, lack of institutional policy (Ergado, 2019; Tibebu, Bandyopadhyay, & Negash, 2009), lack of proper access to ICT infrastructure (Alemu, 2015; Ministry of Education, 2017; Tibebu, Bandyopadhyay, & Negash, 2009) deficiency of instructors' and students' ICT skills (Ergado, 2019; Tibebu, Bandyopadhyay, & Negash, 2009), lack of management and technical support (Alemu, 2015; Ministry of Education, 2017; Ergado, 2019; Tibebu, Bandyopadhyay, & Negash, 2009), shortage of time, lack of incentives and instructors' resistance (Ergado, 2019) are the major challenges to ICT integration in Ethiopian HE. As a result, as with any

other developing countries, ICT is underutilized in Ethiopian HE (Alemu, 2015; Ergado, 2019; Tibebu, Bandyopadhyay, & Negash, 2009) and yet to benefit from its educational affordances.Therefore, determinants of instructors ICT use in HE in developing countries is a relevant and topical educational issue to be examined.

3. ICT use context in HE in developing countries

The way technology is understood, introduced and used in developing countries has its own physiognomies. There are indications in literature that the introduction of ICT in developing countries is not based on the inherent needs and demands of the countries. For instance, Lubin (2018) argues that developing countries have no real rationale (imitated from developed countries) for introducing ICT in education. This could mean that in developing countries, the introduction of ICT is not evidence-based. The countries may rather introduced ICT into their education system because either developed countries have already been using it or are reinforced by donors. Lubin (2018), further claims that ICT is a gift from developed to developing countries and is an "exported priority" as a strategy for international assistance implying its decontextualized use. Kundi, Nawaz and Khan (2010) in their study of predictors of success for E-learning in HE in Pakistan, for instance, concluded that "the main reason for the gap between theory and practice is the lack of research about the domestic environment to record the local context, user views and requirements, and thereby plan accordingly" (p. 568). These authors further indicated that when E-learning models are adopted without having adapted to the new context, their implementation and effectiveness may encounter considerable challenges (Kundi et al., 2010). In the subsequent paragraphs, some major features of developing countries' contexts that have implications on ICT use in HE are discussed.

The political environment

Differences in political environment between countries could create a different environment in which ICT is used. For example, the level of technological advancement of a country heavily relies on the will of people in political power, Khan, Hasan and Clement (2012) argue. Political leaders who are optimistic about technology support ICT use with the necessary resources. "If the political leaders favor technology, it will bloom" (Sharma, 2003, p. 514). However, for political leaders in many developing countries, it does not seem that ICT is a priority. Khan, Hasan and Clement (2012), states that financial investment in ICT in developing countries is not attractive as it is not among their priorities. Furthermore, investment in educational technology in most developing countries does not seem to emerge

from the leaders' recognition of the potential role of ICT in education. It rather seems to arise from the leaders' interest either to gain popular support or simply because they heard or know that the world is doing it. The political instability in developing countries, particularly in Africa, could be one of the challenges to ICT adoption (Sabi et al., 2018).

The economic environment

The level of availability of technological infrastructures is contingent upon the country's economy. In her study of the determinants and effects of ICT diffusion in developing countries, Baliamoune-lutz (2003), for example, found that the level of income influences ICT diffusion and access to technology. Providing HE with the required ICT infrastructures demands a high level of financial investment which is perplexing for many developing countries, where many people live below the international poverty line. Developing countries are often unable to make adequate investments in ICT (Sharma, 2003). This might imply that though there is a political will in some of these countries, the lower level of economy hurdles investment in education in general and in ICT in particular. A report by the World Bank shows that financial constraint is the major problem of many universities in developing countries indicating that in comparison to developed countries, expenditure per student in developing countries is low (World Bank, 2000). On top of this, most public HE institutions in developing countries seem to heavily rely on the central government for their financial resources and, consequently, must wait for the government's hand to execute every operation. This is because they lack strong revenue-generating strategies (Mamo, 2015) and even those collecting revenues from different sources (e.g., tuition fees) cannot utilize as the revenues collected directly go to the government treasury (World Bank, 2000). Such a heavy reliance on the government's budget may challenge universities in acquiring basic educational inputs like ICT infrastructures which is one of the major challenges to universities in developing countries in using ICT in education (Farrell et al., 2007).

Studies indicate that HE in developing countries like Africa has minimal access to computers and the internet as compared to the rest of the world. Steiner, Nyaska, Jensen, and Karanja (2008), in their study of African tertiary institutions connectivity, for example, indicated that on average, a university in Africa has internet connectivity which is equivalent to a broadband connection available at a residential home in Europe. They further indicated that universities in developed countries pay 50 times less than universities in developing countries pay for an equivalent bandwidth service. For many universities in developing

countries, it remains a challenge to be able to afford the upfront cost of purchasing and running ICT system required for supporting teaching and learning (Sabi et al., 2018).

The educational environment

The educational environment of countries may have also implications on ICT use in education. The educational philosophies, the profiles of students and teachers, the governance and the educational programs, and the pedagogy employed in HE in developing countries have their characteristics. The teaching method in HE in many developing countries seems to be outmoded (Buabeng-Andoh, 2012) in which the main role of the teachers is to transfer ready-made knowledge to the students by copying their notes on the blackboard. In addition, HE in many developing countries including at the so-called "flagship universities" suffer from lack of highly qualified faculty (Mamo, 2015; World Bank, 2000). Similarly, HE in Ethiopia is characterized by a large class size (80-100 students per class), novice teachers (young majority with qualification of Bachelor and Master's Degree), teacher-dominated pedagogy, and limited funding (Geda, 2014). Shortage of sufficient and motivated staff could possibly be attributed to lack of professional ladder for instructors, low payment and remuneration, and a poor working environment (Van Deuren et al., 2016). There are also studies which indicate that educational programs in HE in many developing countries seem less relevant to local demands as the curricula are decontextualized. A recent nationwide study by the Education Strategy Center (ESC) of Ethiopia indicates that the curricula being used in HE are not geared towards the development of employability skills of graduates (MOE, 2017). The study further indicates that HE in the country lacks strategies to integrate ICT in its academic programs despite ambitions to do so. These differences in instructors' and students' profiles, teaching methods and curriculum designs perhaps create a different setting in which ICT is used.

Studies also indicate that universities' governance and autonomy (freedom of universities to manage their affairs without unnecessary government interference) in developing countries are also highly compromised to the extent that leaders have limited power to manage their internal affairs because of the long hand of governments. A report by the World Bank (2000) shows that the tendency of political leaders to interfere in HE has made the institutions lose autonomy to make decisions on such things as student selection, faculty recruitment and promotion, and curriculum development. Such decisions tend to have more political basis than merit. Akalu (2014), for example, claimed that, in Ethiopia, the frequent interference of government in the name of accountability has reduced the role of HE to mere implementers of government policies and interests. The weak institutional autonomy

has influenced Ethiopian HE to the extent that even few universities generating small amount of funds cannot autonomously and flexibly use the revenues (MOE, 2017). The same study indicates that absence of accountability, lack of transparency and weak participation of key personnel in planning are some of the challenges facing the governance of Ethiopian HE (MOE, 2017). In addition, top management bodies of HE in Ethiopia are stretched with monotonous non-academic activities and, hence, have little time and emphasis for strategic issues pertinent to teaching and learning (e.g., introducing and institutionalizing the educational use of ICT in universities), research and community development (MOE, 2017). Interferences and strong control over HE might imply that HE leaders need to get the will of people in political position (in most cases people who may have little or no experience in working in the context of HE) to make strategic decisions like investment in ICT. Such strong dependency on external bodies may obstruct the pace and magnitude of adoption of innovations like ICT in HE.

The cultural environment

The cultural environment has also its own role in creating a unique ICT use context. National culture creates either an enabling or hindering environment for innovations to penetrate. In cultures where innovations are valued and welcomed, it is more likely that ICT diffuses easily and quickly compared to a culture that is closed to innovations. Scholars argue that both national and organizational culture can frame the individual perception of innovations like ICT (e.g., Chen, Mashhadi, Ang & Harkrider, 1999; Loch, Straub, & Kamel, 2003). For example, in his study on the impact of national culture on worldwide e-government readiness, Jovacic (2005) found that culture has an influence on worldwide E-Governance readiness. Studies further show that the culture of educational organizations has an impact on instructors' and students' use of ICT (e.g., Albirini, 2006; Mumtaz, 2000; Zhu, 2015). Chai, Hong and Teo, (2009) claimed that organizational culture influences teachers' use of ICT by shaping their beliefs regarding ICT use in education. Any effort of using ICT that disregards local and national culture may not result in the desired outcome. Balasubramanian and Clarke-Kah (2009) claimed that, in many HE contexts, ICT has more impact on administrative operations than on teaching and learning due to the fact that ICTs used in education are unable to consider local needs and culture. African universities lag behind the world in terms of ICT uptake because of prevalent perception that imported technologies and knowledge may erode indigenous culture and identity (Njenga, 2018). These unique socio-economic and cultural contexts could be a reason for HE in developing countries

to experience unsatisfactory level of (western oriented) technology integration and low implementation success (Sakala, 2019).

To sum up this section, developing countries have their own political, technological, educational and cultural environments that may have implications and repercussions on ICT adoption. It is, therefore, assumed that studies on ICT use in HE in developing countries may yield findings that consider the actual context in which HE operates. Furthermore, it is anticipated that because of unique scenarios of developing countries discussed above, an ICT use model that considers the context of developing countries is needed if institutionalized and sustained use of ICT are to be ensured. This study, therefore, aims at scrutinizing determinants of instructors' ICT use and proposes a model of determinants for HE in developing countries.

4. ICT in education: What is in it for HE in developing countries?

In response to the increasing demand for more qualified graduates by employers, contemporary approaches to teaching and training in HE are now in favor of competence-based curricula i.e., a curriculum that centers on the competence and performance of graduates (Kouwenhoven, 2009). These types of curricula, among others, are characterized by learning environments that promote the development of competencies, learner-centered instruction and recognition of learning processes as a heart of instruction (Kouwenhoven, 2010; Kouwenhoven, 2009; Field & Drysdale, 1991). The implementation of such curricula demands access to an abundant variety of information sources, use of such contemporary teaching methods as problem-based learning, cooperative learning and inquiry-based learning, and the changing role of teachers as facilitators (Oliver, 2002; Stephenson, 2001) because competence-based education promotes student-centered approach learning (Kouwenhoven, 2009). In this regard, the use of ICT could increase accessibility of course resources to both teachers and students (e.g., Kozlova & Pikhart, 2021; Pinto & Leite, 2020), enhance learning motivation (Duță & Martínez-rivera, 2015; (Jianzhong, Cha, Benjamin, 2011; Peter, Lucke, & Dunn, 2017; Navas-Parejo, Carmen, Gerardo, & Ramos, 2020), promote collaboration among students (Duță & Martínez-rivera, 2015; Navas-Parejo et al., 2020) and enhance engagement in learning (Duță & Martínez-rivera, 2015; Pellas & Kazanidis, 2015; Lim, 2017; Peter et al., 2017; Tomas, Lasen, Field, & Skamp, 2015).

Learning flexibility has been increasingly demanded in HE. All over the world, the demographics of the students have been changed from the conventional undergraduate entering university directly after secondary school toward unfamiliar numbers of post entry-

level learners, such as those who need access to HE from their workplaces(Collis & Moonen, 2011). To stay relevant and competitive, HE institutions have been extending their services to learners using ICT without spatial constraint. ICT has a potential in enabling HE institutions to provide learning opportunities for those who were constrained by multiple official and social commitments to attend the traditional face-to-face class (Barak, 2018; Hong & Songan, 2011; Hattangdi & Ghosh, 2008).

In the present day and age, education that equips graduates with innovative skills and competencies is highly valued. These skills and competencies are termed 21st-century skills and competencies. According to Ananiadou and Claro (2009), they are called 21st-century skills to show that they are more related to the needs of the current economy than the past. These skills include learning and innovation skills like critical thinking, problem-solving, creativity and innovation and communication and collaboration skills, information, media and technology skills, life and career skills such as flexibility and adaptability, social and cross-cultural skills and leadership and responsibility and lifelong learning skills (see Greiff, Niepel, & Wüstenberg, 2015). If HE institutions must address the emerging demands of the labor market, they need to integrate these skills into their curricula. This demands HE makes use of contemporary ICT tools. Interventions-based studies (e.g., Supriyatno et al., 2020) and self-reported survey studies (e.g., Liesa-or, Latorre-cosculluela, & Sandra, 2020) indicate that ICT use improves students critical thinking skills. ICT is also percieved by instructors to have a positive impact on students communication skills (Liesa-or, Latorre-cosculluela, & Sandra, 2020). Reviews of studies similarly indicate that the use of ICT improves digital literacy, creative thinking, communication, collaboration and problem solving abilities (e.g., Papanastasiou, Drigas, Skianis, Lytras, & Papanastasiou, 2019).

Internationalization, which refers to the process of making HE missions namely, teaching, research and services available to the needy without geographic boundary (Poter, 1990) has become a common strategy in many HE to boost access and delivery of education. Internationalization has many forms such as student exchange, faculty exchange, internationalization of curricula, having branch campuses and institutional cooperation agreements and networks (Damme 2001). The role ICT may play in the process of HE internalization is enormous. For instance, ICT is argued to facilitate borderless HE, vanquish barriers related to countries' regulatory policies, enables partnerships between international institutions for joint training programs and engages students in educational programs without leaving their country (Henard, Diamond & Roseveare, 2012). As a result of the introduction of virtual internationalization, it seems that nowadays, physical mobility could no more be an

essential characterizing feature of internationalization. By using ICT HE institutions may achieve purposes of virtual internationalization (Bruhn, 2017). In the current discourse of HE internationalization, ICT has been recognized as a crucial tool (e.g., Lima, Bastos, & Varvakis, 2020; Ubogu & Veronica, 2020). Specifically, in relation to the impact of COVID-19 on HE (e.g., difficulty of staff and students exchange due to travel ban restrictions), ICT seems to have been a crucial solution to such problems (Woicolesco et al., 2021). HE institutions in developing countries could engage and benefit from internationalization by using ICT.

Massification, i.e., "the movement towards increasing access for university-age students" (Hong & Songan, 2011, p.1277) is among the contemporary developments in HE across the globe (Altbach & Altbach, 1991). "It includes efforts to transform HE from being elitist to encouraging mass participation from different social, income and geographic groups" (Hong & Songan, 2011, p. 1278). Cognizant of the role of HE in socio-economic and technological advancement through the formation of human capital, many countries have been expanding access to HE to their citizens. However, this expansion of HE has compromised the quality of education, particularly in countries like Ethiopia (Mohamedbhai, 2014) due to an increasing number of students coming to universities and colleges, without improving important inputs such as physical infrastructures and qualified academic staff members. The use of ICT in HE in this regard can, therefore, be crucial in addressing the challenges of shortage of educational inputs (International Association of Universities, 1998; Thune & Welle-Strand, 2005). For instance, ICT can partly address the shortage of qualified academic staff by the interconnection of many lecture rooms so that a lecture delivered by one professor can be simultaneously transmitted to the others by videoconferencing. Cognizant of the role of HE in accelerating the country's development, the Ethiopian government has been committed to expanding HE. As a result, a huge proportion of the budget allocated for HE goes to the construction of physical classrooms and dormitories. However, scholars such as Mumtaz (2000) argue that, through the use of ICT, the governments may address these demands with reduced cost as ICT supported education does not necessarily demand physical classes. Bulu Swarupanjali and Biswa (2009) and Drury (2005) state that developing countries, where access to HE is a chronic problem, might be particular beneficiaries of ICT mediated learning.

ICT is known to play a pivotal role in enabling learning and teaching to take place during global educational crises owing to natural and man-made disasters. For example, all over the world, around 500 million children and youth were not able to attend classes in-

person due to school and university closure in response to the containment of the COVID-19 spread (W. Ali, 2020). This has created a scenario in which HE institutions are sandwiched between two requirements which is not straight forward to reconcile. On the one hand, HE institutions need to strictly implement lifeguarding measures set by the WHO such as social distancing and, on the other hand, they must resume learning and teaching if they want to survive. Consequently, ICT becomes an incomparable solution globally to climb out of this challenge and as a result literature presenting ICT as panacea for educational issues in the time of crisis has started to appear (e.g., Kerres, 2020). Owing to the role of ICT in enabling education during such disasters, globally, ICT supported education is emerging and evolving quickly (Ali, 2020). In addition, for developing countries, when attending class in-person is challenging due to man-made disasters such as clashes and conflicts, ICT can still play a critical role in sustaining teaching and learning.

The potential of ICT in transforming HE in developing countries and enabling education during crisis coupled with a continuous international promotion to use ICT in education (Sakala, 2019) has led many developing countries to substantially invest in ICT. Many of these ICT use initiatives are supported by international organizations, donors and private organizations (Lim, Ra, Chin & Wang, 2020) with the goal of increasing availability and development of new ICTs (El Alfy, Gómez, & Ivanov, 2017). Nevertheless, research evidence point out that ICT is far from being meaningfully integrated into HE of developing countries and yet to see its educational gains (Balarabe Yushau, 2018; El Alfy, Gómez, & Ivanov, 2017; Esnaola-arribillaga, 2020; Ed, Watty, Mckay, & Ngo, 2016; Zander, 2016). Furthermore, studies indicate that the level of ICT use by instructors for academic purpose is not satisfactory even in HE institutions where ICT infrastructures are reasonably available (see e.g. Martirosyan, Kennon, Saxon, Edmonson, & Skidmore, 2017; Ellaway, 2011). In many countries, ICTs were introduced into educational institutions not as a means of improving teaching and learning but as an end by itself (Young, 1991). Such a "techno-centric" approach to the introduction of ICT into HE may hinder its use and resultant impacts as the uncontextualized ICT use from learning goals may not facilitate students' learning. Many HE institutions including those claiming themselves as committed to the realization of contemporary trends such as internationalization are not sufficiently adopting ICT for teaching and learning purpose (Henard et al., 2012). It is, therefore, necessary to examine the factors that determine instructors' use of ICT use in HE in developing countries. The enhanced investment in and access to ICT, on the one hand and, its sustained underutilization in HE in developing countries, on the other hand, necessitates the investigation of what

determines instructors' ICT use and to propose a generic model of determinants that could apply to both the contexts of developing countries as well.

5. ICT use

Educational ICT use is conceptualized in several ways in literature. For example, Baylor and Ritchie (2002) conceptualized ICT use as using ICT as a subject of study versus instructional tool. Also, Smeets (2005), identified skill-based versus open-ended software use of ICT. ICT use is also understood as basic computer skills, ICT use as an information tool, and ICT use as an instructional tool (see Tondeur, Van Braak, & Valcke, 2007). Professional use of ICT (supportive and managerial)(see Meneses et al., 2012), supportive versus classroom use of computers (see Van Braak et al., 2004) are also other ways of conceptualizing ICT use.

As the very aim of this study is to examine determinants of instructors' ICT use for teaching and learning purposes, it capitalizes on the professional use of ICT. However, unlike the professional ICT use conceptualization of Meneses et al., (2012) which is delimited to merely the supportive and managerial ICT use, the professional use of ICT in the context of this study extends to comprise the supportive, managerial and classroom uses as well. The supportive use of ICT (e.g. searching supplementary materials online), the administrative and managerial use of ICT (e.g., using e-mail to communicate with colleagues and students), and classroom use of ICT (e.g., using ICT as a tool for demonstrations in the classroom) are assumed to be related instructors' educational use of ICT. Empirical studies also indicate that the use of ICT for preparation of teaching materials, retrieval of educational resources, classroom presentations and communication are the most frequent educational use of ICT by instructors (Gülbahar, 2008; Mwalongo, 2011; Sipilä, 2014). In this study, thus, ICT use involves the use of computers, the internet and their applications for any of the aforementioned educational purposes (supportive, classroom and managerial).

6. Theoretical perspective

In research on ICT use/integration, several models and theories have been developed. Despite some commonalities, these theories and models hypothesized different constructs that predict individual's behavioral intention and actual usage of technology. These models have emerged as a result of a continuous search for a robust model that accounts for high variance in individuals' technology adoption. This research aims at examining the complex relationships between determinants at different levels and ICT use. No theory is complete by itself (Moksony, 2020) to encapsulate and understand multifarious determinants of ICT use.

Hence, in order to benefit from the relative strengths of each of the models and inform the study with a model that has a broader perspective, integration of the following two theoretical models informed the current study.

The will, skill and tool (WST) model

The WST model of technology integration is developed by Christensen and Knezek (2001). The WST model of technology integration states that will (attitude towards ICT), skill (ICT competence), and tool (access to ICT) have a direct influence on ICT use (Sasota et al., 2021). The WST model is parsimonious yet multidimensional in explaining technology use (Sasota et al., 2021), and past studies using the model reported its strong explanatory power (96% variation in ICT use is explained by ICT competence, attitude, and access) (Farjon et al., 2019).

The RIPPLES model

RIPPLES is an acronym that stands for **r**esources, **i**nfrastructure, **p**eople, **p**olicies, **l**earning, **e**valuation and **s**upport. It is a model developed by Surry and his colleagues (Surry, Ensminger, & Haab, 2005) to study factors associated with the integration of ICT in HE. RIPPLES is developed based on review of Rogers Diffusion of innovation theory (Rogers, 1995), Hall and Hord's Seminal work on change in schools (1987), Ely's eight conditions for ICT adoption (Ely, 1999), the critical factors in adoption checklist developed by Stockdill and Morehouse (1992), Burkman's (1987) user-oriented instructional development model, and the concept of adoption analysis developed based on "Dean's survey" (Surry, Ensminger & Haab, 2005). According to Surry and his colleagues, the following seven factors are crucial for the integration of technology in HE.

a. *Resources:* Technology adoption cannot take place in a vacuum. It demands money to purchase basic ICT infrastructure and learning materials (Goeman, 2008).

b. *Infrastructure:* ICT hardware, software, facilities, and network infrastructure are pre-requisites for the adoption of any form of technology (Goeman, 2008).

c. *People:* This refers to the critical role that the needs, hopes, values, skills, and experiences of people play in integrating technology in HE.

d. *Policies:* Organizational policies and procedures are fundamental in governing and guiding technology adoption. Organizational Policies are instruments for reinforcing innovation adoption in HE.

e. *Learning:* This refers to the role of technology in reforming teaching and learning. If technology is to be successfully adopted, the university management and teachers need to view technology as a tool that can enhance the teaching-learning process.

f. *Evaluation:* The integration of technology into teaching and learning should be evaluated on an incessant basis. Evaluation of the adopted technology should be carried out considering its role in realizing learning goals and costs and benefits of implementing the technology.

g. *Support:* This component of the model deals with the arrangement of user support systems to assist technology adopters. The support component includes training, technical support, pedagogic support, and administrative leadership.

Some scholars (e.g. Goeman, 2008), a decade ago, argued that RIPPLES is a model which is not well tested. However, it has been used as a theoretical perspective of ICT integration in HE research in several studies including Ph.D. dissertations since its birth. Vandover (2013), in his study titled, "Organizational Decision Making Related to Instructional Technology at Small Liberal Arts Colleges and Universities", used the RIPPLES model and found that the resources, people, policies, and evaluation dimensions of the model provided the most salient findings of organizational decision making regarding instructional technology. Nyirongo (2009) also used the RIPPLES model in her research titled, "Technology Adoption and Integration: A Descriptive Study of a HE Institution in a Developing Nation" and came up with the finding that lack of training, lack of technical, pedagogical, and administrative support; and lack of faculty involvement in decision making relating to electronic technologies are major factors that influences the integration of electronic media in HE. Jasinski (2007), used the seven components of the RIPPLES model to study the implementation of web-based learning among vocational educators in Australia and, consequently, reported that all the seven components of the model are important and need to be considered while adopting technology. Benson and Palaskas (2006) similarly used RIPPLES to study the adoption of a LMS in Monash University and proved that the model appears to be a useful tool for analyzing the integration of technologies such as LMS.

Unlike the other technology acceptance models such as the theory of reasoned action (TRA), theory of planned behavior (TPB), technology acceptance model (TAM) and the unified technology acceptance and use theory (UTAUT), which focus on individuals attributes as the focal factors for technology adoption, the RIPPLES model forms a broad

theoretical ICT adoption model that enables to capture institutional characteristics that influence technology adoption in the context of HE (Benson & Palaskas, 2006). In addition, RIPPLES is a model that has its base on previous theories such as the theory of diffusion of innovation and Ely's eight conditions, and developed to inform ICT integration in the context of HE (Gagnon, 2012). Hence, it is plausible that RIPPLES is more appropriate as compared to the rest of the models/theories in informing the present study. It is, therefore, assumed that the integration of the RIPPLES and the WST models provides a broader perspective to capture individual and institutional characteristics that determine instructors' educational ICT use in HE in developing countries.

7. The research gap

Educational technology research has been one of the research areas of interest of many educational researchers since decades ago. Today, due to the increasing demand for the use of ICT to address various educational issues, educational technology research has become among the areas of research that has attracted the attention of educational researchers globally. Most of the previous studies that examined ICT use in the context of education were conducted in the developed world (Islam & Grönlund, 2016), hence, less is known about the issue in developing countries (Aydin & Gürol, 2019). In addition, literature on determinants of instructors' ICT use in developing countries, particularly in Africa is scarce, as the few studies that exist focus on students' ICT use (Bervell & Umar, 2017). Though the decision to use technology in teaching and learning mainly rests on instructors, their role and voice are not sufficiently addressed in the previous studies. Studying the experiences and perspectives of instructors in the context of educational ICT use is essential as instructors are are argued to be agents who essentially assume the responsibility of integrating ICT and its integration into teaching and learning would hardly take place in their absence (Ra, Chin, & Lim, 2016; Safar, 2015; Voogt, Knezek, Cox, Knezek, & ten Brummelhuis, 2011).

Moreover, previous studies on the determinants of instructors' ICT use predominantly adopted technology acceptance models as a guiding framework (Bervell & Umar, 2017) with limited consideration regarding the influence of institutional factors on ICT use (Bervell & Umar, 2017). As a result, there is a scarcity of studies that examine determinants of instructors' use in the context of developing countries.

As discussed earlier, one of the challenges to the successful integration of ICT in HE in developing countries could be the practice of ICT use that is detached from its context (Muhammad & Albejaidi, 2017; Lubin, 2018). It is, thus, plausible to assume that because of

unique economic, social, educational, technological and cultural contexts discussed in section three of this introduction, in developing countries, ICT use in HE is influenced by other determinants. For example, higher education institutions (HEIs) in developing countries operate with meager resources due to a poor economy or that ICT use is a fairly new phenomenon (Elshaikhi, 2015). Due to these conditions (scarcity of resources and lack of experience), ICT use is yet to be an integral part of their teaching and learning activities (Barakabitze et al., 2019; Baliamoune-lutz, 2003; World Bank, 2000). As Goeman (2008) argued, the role of policy and institutional contexts are decisive in the adoption of technology. Given the above considerations (underrepresentation of evidence from developing countries, little attention given to instructors and lack of a context-driven model of instructors' ICT use determinants), it seems that further scrutiny is necessary to generate a generic (a model that is applicable to developing countries as well) and parsimonious (consisting of only a few variables that each have a high predictive value) instructors' ICT use model for HE in developing countries. The need for a profound, contextualized study of factors that determine ICT uptake and sustained use in HE in developing countries is assumed by taking Ethiopia as an example.

Investigation of factors that determine instructors' ICT use in the context of developing countries may have paramount theoretical and practical significance. Despite increased appetite and expansion of ICT infrastructure witnessed in the past decades in developing countries, ICT uptake and its successful utilization in HE in these countries is yet to be realized. Hence, this research would fill in this gap by examining factors that influence instructors' ICT use in HE in developing countries and by giving direction to what needs to be done and how to facilitate ICT use based on the research findings. Policymakers, leaders, and experts in HE in developing countries need to know ICT use determinants which are relevant to their specific contexts. Such pieces of evidence (the study findings) enable the leaders of HE to make informed decisions and ensure economies of scale (the limited resources can be wisely used to create an empowering ICT use environment in the HE). From a theoretical point of view, this study may add to the existing knowledge by unveiling determinants of instructors' educational ICT use in the context of developing countries. Such investigation would fill in the literature gap regarding evidence from developing countries.

8. The research questions

Given the above considerations, the present research project intended to investigate one central issue, namely the factors that determine instructors' educational use of ICT in HE in Ethiopia. The study is guided by the following three specific research questions:

a. How do instructors in HE in Ethiopia use ICT for educational purposes?
b. What do instructors in HE in Ethiopia perceive to determine their ICT use?
c. Which perceived factors predict instructors' educational use of ICT significantly?

9. The research method

The study employed a mixed-method research design. Johnson and Onwuegbuzie (2004) formally define mixed methods research as "the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study" (P. 17). The core argument for a mixed-methods design is that the integration of both forms of data provides a better understanding of instructors' ICT use and its determinants than either quantitative or qualitative data by itself (Creswell, 2012). It is believed that the goal of the present study (developing a generic and parsimonious ICT use model) may not be adequately studied by either a purely quantitative or qualitative approach. The use of either of the approaches may limit the comprehensiveness of the data and the accuracy of the findings. Selection of the method was, thus, guided by the research questions. Emphasis is given to the understanding of the most relevant determinants of instructors' ICT use in the context of Ethiopia instead of which method to apply or theoretical lenses to adopt (Almalki, 2016; Migiro & Magangi, 2011; Johnson et al., 2004).

This study specifically employed the exploratory sequential mixed-method to answer the three basic research questions. In this design, the qualitative data were collected and analyzed first to inform the subsequent quantitative phase (Creswell, 2012) which also applies to this research project. In this study, findings obtained from the qualitative phase were used to frame the quantitative phase which aimed at testing the proposed model of determinants of instructors' ICT use on a large and diverse sample (Creswell & Clark, 2007). Accordingly, the first and the second research questions were tackled through an exploratory qualitative study based on data collected from instructors via focus group discussion (FGD). The very purpose of exploring instructors' perception regarding their ICT use practice and its determinants was to generate evidence that enables to appraise an initial research model hypothesized based on a review of literature so that a more realistic model can be proposed and tested via a follow-up quantitative investigation (the third research question). The third research question aimed at

(a) testing the relevance of the model hypothesized based on a review of literature and evidence generated from the qualitative exploration and (b) investigating the relationship between ICT use and its determinants and their predictive capacity based on survey data collected from instructors. The result obtained from the quantitative investigation was used as a foundation for proposal of a generic and parsimonious model of ICT use responsive to the context of developed countries.

The study was conducted in three major phases. These are phase one (qualitative phase), phase two (quantitative phase) and phase three (proposal of a generic model). The first phase of this research project consists of two qualitative studies. The first study involves an exploration of the state-of-the art of instructors' ICT use in Ethiopian HE context. And, the second study deals with the qualitative investigation of determinants of instructors ICT use.

The qualitative phase of this study had an added value in that evidence generated at this phase enabled to confirm the relevance of determinants in the hypothesized model and throw up a light vis-à-vis new determinants for consideration in the context of Ethiopia. It also assisted in illuminating how ICT is used by instructors so that a context-driven conceptualization of ICT use in the study setting was achieved. In short, this phase has made it possible to lay strong foundation for the subsequent quantitative phase by proposing an ecologically valid model in the Ethiopian context. The qualitative and quantitative investigations are successive phases as the former informs the latter The second phase of the study deals with quantitative investigation of the relationship between instructors ICT use and its determinants. In the final (third phase) a model of determinants of instructors' ICT use is proposed by integrating the empirical findings and review of the literature (see Figure 1).

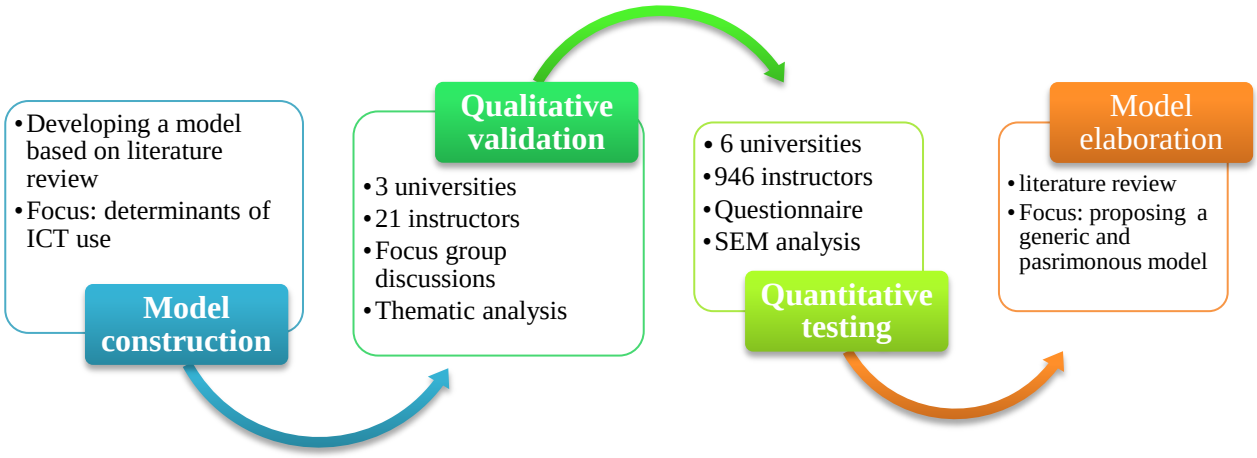

Figure 1: *Schematic representation of the research process*

10. Organization of the dissertation

Three empirical studies and a model constitute the present dissertation. The three empirical studies were conducted to address the research gap identified in section seven of this introductory section. The proposed model was formed by integrating empirical (data generated from prior studies) and conceptual (review of the literature) components in view of presenting a more elaborated model of instructors' ICT use in developing countries. The proposed model is, therefore, partially an output of the empirical studies. In the section that follows, the three studies and the proposed model are described.

Chapter two: This chapter deals with the first study. The central theme of this project concentrates on ICT use. Instructors may use ICT in different forms for different purposes in different contexts. In addition, as discussed earlier ICT use is conceptualized in different ways in literature. Hence, an ecologically valid conceptualization of ICT use is necessary for context- sensitive studies such as the current one. However, it was not clear, at the beginning of the research project as to how instructors in HE in Ethiopia use ICT for educational purposes. It was, therefore, reasonable to start the research project by exploring instructors' perceptions of how they use ICT. The exploration of instructors' experiences not only framed how instructors' ICT use needs to be conceptualized in the context of Ethiopian HE but also how it needs to be operationalized in that specific context. The first research question (study), therefore, explored how instructors in HE in Ethiopia use ICT for educational purposes through an exploratory qualitative study based on data collected from instructors via focus group discussion (FGD)

Chapter three: This chapter discusses the second study that aimed at exploring what instructors in Ethiopian HE perceive to determine their educational ICT use. Firstly, a guiding conceptual framework for the study was developed based on a formal review of available empirical studies and theoretical claims. The conceptual framework guided the research process by presenting a schematic representation of the theoretical constructs of interest in relation to instructors' ICT use. The major purpose of the conceptual framework was to light up critical determinants of instructors' ICT use. Based on a review of the literature, in the theorized model, institutional and individual characteristics were proposed as major determinants of instructors' ICT use in the context of HE in developing countries. However, we assumed that this model could be challenged for it may lack applicability to be used in the Ethiopian context. This is because most of the empirical studies and theoretical claims used to develop the model are based on theoretical frameworks that had their origin in developed countries. It was, therefore, plausible to conduct a preliminary qualitative study to appraise

the proposed model before testing it quantitatively. Like the first research question, the second research question (study) was tackled through an exploratory qualitative study based on data collected from instructors via focus group discussion (FGD)

Chapter four*:* This chapter presents the third study that investigated quantitatively the factors that determine instructors' ICT use. To this end, via a review of literature, a model of determinants of instructors' ICT use was hypothesized taking the context of developing countries into account. The literature review also indicates previous papers that aimed at developing a generic and parsimonious model that has the least possible determinants but strong predictive power (Vandekerckhove & Matzke, 2015). This part of the study examined the causal relationships among a multitude of institutional and individual determinants of instructors' ICT use that were drawn from literature and supported by the qualitative findings. It examined integrative causal relationships between the identified determinants and ICT use using structural equation modeling (SEM) to indicate patterns of effect (path analysis) and the magnitude of each of the predictors to highlight key factors.

Chapter five: In this chapter, a generic and parsimonious ICT use model relevant to the context of developing countries was proposed. The proposed generic model was derived from the limited explanatory power of the instructors' ICT use model that was developed and tested via the prior studies. The aim of this phase of the research was, thus, to propose a generic model of instructors' ICT use model with a better parsimony. The proposed model capitalized on the findings of the prior studies and elaborated the determinants based on further review of the literature. The proposed model consists of empirical and conceptual parts and integrated determinants from different categories. Despite intensive work to bring the model to its current status, it is yet to be finished. However, the model may be considered as a springboard to foster the development of a parsimonious ICT use model responsive to the context of HE in developing countries.

The last chapter (**chapter six**) presents the general discussion and conclusions based on the main findings of the three studies and the proposed generic model. The findings are integrated and interpreted in relation to the theoretical and empirical claims in a broader perspective of Ethiopian HE and other contexts. This chapter does not only reflect on questions that emerge from the study but also discusses at length how the findings can be translated into actions that facilitate instructors' educational ICT use in HE in the context of developing countries. In sum, this part is devoted to a critical reflection of the theoretical relevance of the findings in advancing the existing knowledge horizon regarding determinants of instructors' educational ICT use and how the findings can be transformed into practice. In

addition, this chapter deals with reflections on the strengths and limitations of the research, conclusions as well as trajectories for future studies.

Chapter Two: Instructors' Educational ICT Use in Higher Education in Developing Countries: Evidence from three Ethiopian Universities

Abstract

Developing countries exert much effort to improve the quality of their higher education. The use of information and communication technology (ICT) may address some of the quality problems in higher education in these countries. Previous studies on this topic stressed the impact of ICT use on learning, the status of ICT integration in education, and the factors associated with ICT integration with minimal attention to how instructors in higher education in developing countries use ICT. This study employed a qualitative approach, collecting data from twenty-one by then active instructors in three public universities in Ethiopia through focus group discussion to explore the educational use of ICT. The data were transcribed verbatim and analyzed thematically using ATLAS.ti software. The results show that instructors in the selected Ethiopian universities use ICT for course facilitation, course materials preparation, professional development, assessment, and information and resource exchange purposes. However, these findings do not reveal a transformative use of ICT in education, which may imply that ICT is not used in a manner that alters existing teacher-centered approaches. This study suggests that future studies may focus on why instructors rarely use ICT in a transformative way and developing a tailor-made and efficient model that informs practice.

Keywords: ICT use, higher education, instructors, Ethiopia, Focus group

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1. Introduction

The use of ICT[2] has brought profound changes in teaching and learning practices (Islam, Mok, Gu, Spector & Hai-Leng, 2019; Tiyar & Khoshsima, 2015). However, its impact on student learning outcomes is not clear (OECD, 2015). While some studies point out positive effects (e.g., Akinbadewa, 2020; Álvarez, Martín, Fernández-Castro, & Urretavizcaya, 2013; Naji, 2017; Safar, 2015), others indicate that the use of ICT has brought no considerable improvement (e.g., OECD, 2015). Despite unclear research findings on the impact of ICT on learning outcomes, developing countries, where access to and quality of education are chronic problems, can be particular beneficiaries of ICT-mediated learning (Nawaz, 2013).

In Ethiopia, one of the least developed countries with a total population of 107.5 million (World Bank, 2018), a recent study by the Ministry of Education revealed that higher education (HE) suffers from a lack of quality education. This is mainly expressed in terms of graduates' low employability skills (MoE, 2017). The same study pointed out that HE is characterized by educational programs that are less relevant to the labor market demands, insufficient minimal learning and teaching resources, and outdated instructional teacher-centered approaches that hardly promote the implementation of much needed competency-based curricula.

It seems developing countries like Ethiopia could change existing problems with the quality of education by implementing a transformative use of ICT in HE (Kozma & Vota, 2014). This concept refers to the use of ICT to promote the application of student-centered teaching and learning approaches (Alemu, 2015). It is characterized by: (a) instructors being skillful in using different ICTs creatively and efficiently (Choeda, Penjor, Dukpa & Zander, 2016) rather than using it to repackage the prevailing teacher-centered pedagogy, (b) making ICT use an integral part of teaching and a tool to link learning content to real-world applications (Teo, 2009) and (c) ICT use that is linked to learning goals (Mama & Hennessy, 2013). Scholars such as Alemu (2015) and Barakabitze, Lazaro, Ainea, Mkwizu and Matofali (2019) argue that the transformative use of ICT improves teaching and learning by promoting active, collaborative, and creative learning, and by enabling access to abundant teaching-learning resources. In addition, studies indicate that ICT promotes the development of

[2] In this study, ICT relates to those technologies that are used for accessing, gathering, manipulating and presenting or communicating information. The technologies could include hardware (e.g. computers); software applications; and connectivity (e.g. access to the internet, local networking infrastructure, videoconferencing) (Christensson, 2010, p. 3). ICT use refers to the adoption by instructors of these technologies to support teaching and learning practices.

learners' critical analysis, problem-solving, self-learning, and ICT skills (Khan & Setiawan, 2019). Cognizant of these and other benefits of ICT, HE institutions in developing countries have continued to expand their infrastructure regardless of their poor economic situation (Barakabitze et al., 2019). However, it is not clear whether instructors in Ethiopian HE are using ICT in a way it transforms teaching and learning.

2. Research context

As with other countries, Ethiopia has its own context that might have implications on ICT use in HE. As a result of the massification of HE in Ethiopia, its quality seems to be compromised. In the Ethiopian HE sector, issues of access, relevance, equity and quality remain the major challenges that need to be addressed during the implementation period (2018-2030) of the current education development roadmap (MOE, 2017).

ICT is a relatively new phenomenon to Ethiopia (Alemu, 2017) and its penetration in the education sector is slow (Tibebu, Bandyopadhyay, & Negash, 2009). The Ethiopian government has embarked on ICT-enabled transformation in all sectors, including education, to enhance performance and deliver better public service with the ultimate goal of improving the lives of its citizens (Lixi & Dahan, 2014). In its fifth Education Sector Development Program (ESDP V) 2015/2016-2019/2020 the government vows to commit itself to expanding ICT integration to transform the quality of teaching at all levels of education. In the plan, it is described that during the implementation period of ESDP V, ICT in education policy will be ratified, ICT and internet connection will be provided to all universities; pedagogy, technology, and content will be integrated; ICT will be mainstreamed across core subjects; digital contents will be developed, and a learning management system (LMS) will be in place at all levels of education to support the teaching and learning activities (MOE, 2016). With the postulation that the use of ICT is a key tool to address the multifaceted problems of Ethiopian HE, the government highlighted the need to transform the HE campus environments via ICT and engage in increased investment in ICT. There are several challenges to the use of ICT in Ethiopian HE. Studies indicate that a lack of institutional policy (Ergado, 2019; Tibebu, Bandyopadhyay, & Negash, 2009), limited access to ICT infrastructure (Alemu, 2015; MOE, 2017; Tibebu, Bandyopadhyay, & Negash, 2009), a deficiency of instructors' and students' ICT skills (Ergado, 2019; Tibebu, Bandyopadhyay, & Negash, 2009), a lack of management and technical support (Alemu, 2015; Ergado, 2019; MOE, 2017; Tibebu, Bandyopadhyay, & Negash, 2009), a shortage of time, a lack of

incentives and instructors' resistance (Ergado, 2019) are the major challenges to ICT integration in Ethiopian HE.

3. The research problem

Instructors' ICT use may range from occasional use to facilitate existing teaching and learning practices to a more advanced ICT integration level, which is strongly linked to pedagogical principles and learning objectives (Mama & Hennessy, 2013). The way instructors use ICT influences its impact on teaching and learning. For instance, Mama and Hennessy (2013) observed that ICT integration which is directly linked to lesson objectives, has a higher impact on pedagogical practices than the one delinked from learning objectives. This implies that how instructors use ICT influences its impact on teaching and learning and, hence, deserves attention in a study of ICT use in education.

Scholars have studied and characterized different uses of ICT in education (Baylor & Ritchie, 2002; Mama & Hennessy, 2013; Tondeur, van Braak & Valcke, 2007). These studies mainly focused on primary and secondary schools and were conducted in developed countries. As a result, there is little evidence on how instructors in HE, particularly in developing countries use ICT in a transformative way. The existing few studies in HE in developing countries focus on examining the extent of ICT implementation and its barriers (Asuman & Clement, 2018; Kisanga & Ireson, 2015; Rana & Rana, 2020; Raphael & Mtebe, 2016; Tongkaw, 2013) with little attention to how instructors use ICT. The context of teaching and learning at the HE level is different from that of primary and secondary schools. For instance, teaching and learning in HE focuses not only on training future entrepreneurs but also on informing citizens who can accelerate democratization and socio-economic development processes (Van Deuren et al., 2016). In addition, HE prepares citizens to innovate and transfer technologies that may solve human problems (Lehmann et al., 2020). In this regard, HE contributes to building an inclusive and diverse knowledge society by equipping its citizens with 21st century skills (see Greiff, Niepel & Wüstenberg, 2015). Furthermore, students in HE are expected to be critical thinkers and independent learners who need limited support from their instructors (George & Supreetha, 2021; Raman, 2016). Differences in ICT use practices may also be expected between instructors' in HE in developed and developing countries based on the arguments that: (a) ICTs have largely their origin in developed countries to address educational problems there and are used in developing countries without contextualization (Lubin, 2018), (b) ICT use initiatives in developing countries are mainly donor driven (Barakabitze et al., 2019; Lubin, 2018) and (c)

organizational culture in HE in developing countries is hardly accustomed to ICT adoption (Njenga 2018). Such differences in the context, purpose, and methods of teaching, as well as student profiles may affect how instructors use ICT.

4. The purpose of the study

The current study started from the assumption that different milieus may imply differences in ICT deployment for educational purposes. However, given the shortage of studies about ICT use in developing countries particularly in Ethiopia, we aim to improve our understanding of such contexts in relation to ICT use among HE instructors. In particular, this study explores in a qualitative manner how cohorts of Ethiopian instructors from three universities use ICT for educational purposes. The study's findings are expected to contribute significantly as they unravel for the first time, to our knowledge, the various patterns of and reasoning behind educational ICT usage by Ethiopian HE instructors.

5. Method

This study employed a qualitative approach to explore university instructors' experiences with and opinions about their educational use of ICT in their particular context (Flick, 2018; Merriam, 2002). We opted for a qualitative approach to gather rich, in-depth information on *how* and *why* instructors use ICT for educational purposes (Ary, Jacobs, Irvine & Walker, 2018).

5.1. Selection of participants

Data were collected from instructors working at three universities. These universities represent different categories of institutions. The first is labeled as 'mature', referring to universities that were established between 1950 and 2000, and expected to have relatively (with compared to emerging and new universities) adequate ICT infrastructure, high-qualified instructors, and student enrollment numbers (undergraduate and postgraduate) that range between 20,000 and more than 43,000. The second category ('emerging') refers to universities that were established between 2006 and 2009, with enrollment rates between 3,333 and 15,000. The 'new' universities, a third category, were established between 2010 and 2011, have fewer students and focus mainly on undergraduate programs (Geda, 2014). One university from each category was selected in a purposeful manner. Next, a few instructors from each university contacted and asked to recommend two to three instructors (per faculty) who could participate in the study. If an instructor from a particular faculty or college showed interest to participate, the study's purposes were explained in greater detail. Afterward, an instructor from another faculty or college was contacted. If the person that was

met first did not show further interest, a new instructor from the same faculty or college was contacted. This procedure was repeated until we secured that at least one instructor from each faculty or college from the three universities participated. As a result of this snowball sampling method, 21 instructors have retained as focus group (FG) members. They had various disciplinary backgrounds (Health, Social Sciences, Natural Sciences, Engineering, Agriculture, and Business and Economics) and between 2 and 20 years of teaching experience. More details regarding the profile of the participants can be found in Annex 1.

5.2. Data collection

Data were collected through discussions in FGs. The researchers opted for a FG as it is an effective method for sharing ICT use perspectives by instructors with diversified backgrounds and experiences (Creswell, 2012; Dilshad & Latif, 2013). FG use enables the collection of convergent and divergent views and allows that individual participants' opinions are restructured as a consequence of mutual influences (Flick, 2018). Moreover, particular ideas may occur spontaneously during the conversations. In other words, a FG holds the potential of revealing themes that might be forgotten when interviewing instructors individually (Dilshad & Latif, 2013).

One FG was organized per university. All three FGs were conducted face-to-face in a convenient room permitted by the universities and agreed by the participants. Their duration ranged from 90 to 110 minutes. Prior to the study, all participants were informed about the purpose of the study and the processing of the results. Their participation was voluntary and without compensation. At any moment they could withdraw from the study. Each of the participants signed an informed consent document, as provided by the university ethics regulations. The principal researcher facilitated all three FGs. The discussions were introduced by the question "For which educational purpose do you use ICT?" followed by probing questions such as "How do you use ICT in the classroom? How do you support your teaching with ICT? For what educational purposes do you use ICT outside the classroom?"

All FGs were audio recorded and stored on a computer. The principal researcher transcribed the entire recordings verbatim into regular text files. The parts of conversations in a local language were transcribed and translated into English. The members' checking technique was employed to ensure the study's trustworthiness; the principal researcher sent full transcripts to the participants to have checked whether what they had said during a FG was correctly transcribed (Shenton, 2004; Yin, 2009). More than half of the respondents gave feedback; all confirmed the correctness of the transcriptions.

5.3. Data analysis

Creswell's (2012) six steps of qualitative data analysis were applied. The coding, segmentation, merging and formation of themes were performed using ATLAS.ti qualitative data analysis software. The principal researcher and one co-researcher developed a codebook and coded the first FG dataset together. Afterward, the principal researcher finalized the coding of the remaining two FGs using the agreed codebook. Data are linked to themes at different levels (three in total) based on similarities and commonalities in their meaning. Hence, the findings are organized in such a way that instantiations are sorted out and analyzed in detail. A figure is created, which represents graphically the thematic network of the emerging themes and subthemes. These were derived inductively, as previously noted. Descriptions of the themes are supported by their appearance in the transcriptions. Examples of quotations are provided for illustration in the tables corresponding to each theme in the Results section.

6. Results

As depicted in Figure 1, from the evidence emerged fourteen basic themes grouped under five organizing themes. A summary of all findings regarding ICT use of instructors in each of the three universities can be found in Annex 2. In this, the universities are labeled by pseudo names ‘A’, ‘B’ and ‘C’ while the participants are represented by numbers to preserve their anonymity. When participants’ reflections were very similar, the most representative quote was selected. Square brackets indicate that a part of the transcript has been omitted in order to concentrate on what is key for illustrating the findings.

In what follows, we describe the organizing and basic themes. These are: (1) *course facilitation* consisting of displaying, demonstration, and using presentation slides*;* (2) *material preparation and storage* including lecture note preparation, presentation slides preparation, books and storage; (3) *professional development* comprising self-development and scholastic activities; (4) *assessment* encompassing grading and assessment and (5) *information and resource exchange* consisting of communication and resource sharing.

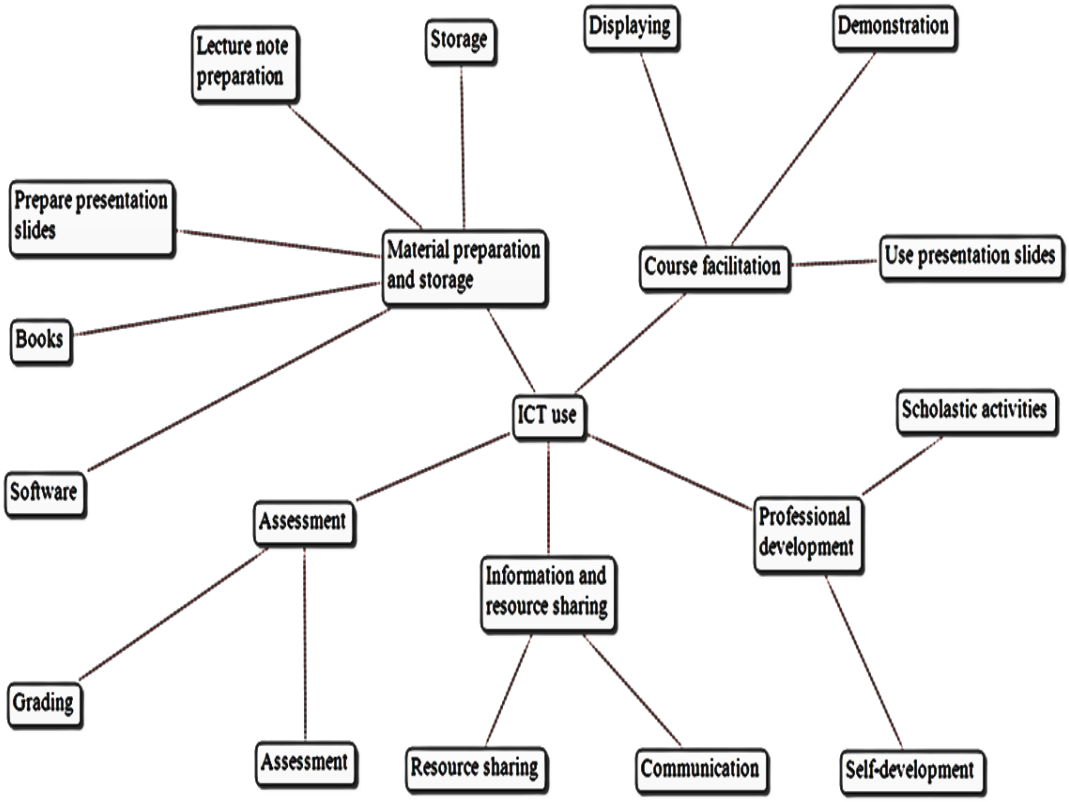

Figure 1: *Thematic network of the emerging themes.*

6.1. Course facilitation

Course facilitation refers to the use of ICT to facilitate course activities in the classroom. It involves instructors' use of computers, internet, intranet, and beamers in the classroom to *display visualizations demonstrate procedures* and *presentation slides* (see Table 1).

Table 1

ICT use for course facilitation

Basic theme	Frequency	Example of quotation
Use presentation slides	19 (90%)	A5*:"I use computers for the purpose of delivering class through PowerPoint […]. It allows us to manage our class because we are not expected to write on the blackboard."* C6:" *We use computer during teaching-learning especially LCD/or power point preparation."*
Display	18 (86%)	A2: *"Visualization makes the lesson more understandable […] it is difficult to explain what glucose is and its molecules, but with computer aid, it is easy for students to understand."* B5: "*We have to use computer and the internet frequently as most of our subjects need visualization or displays of depictions*."
Demonstration	7 (33%)	C6: *"We use ICT to demonstrate some lab activities and procedures, for example, testing certain concentration."* *A6: "while teaching of GIS course, […] I demonstrate weather forecast and temperature .This makes teaching and learning process efficient and very understandable to students".* *C4: "we use videos and animations to make the lesson more concrete and this demands the use of ICT […] In the lab we have deficiencies of equipment and other resources to conduct experiments."*

Presentation slides are one of the purposes for which instructors use ICT in the classroom. It refers to using slides to flash texts and facilitate classroom lectures simply. Instructors prefer to use presentation slides in the classroom as it allows them to cover bulky lessons within a shorter time.

Displaying refers to the use of ICT to flash illustrations for students in the classroom. The instructors stated that they frequently use the internet, computers, and LCDs to portray pictures, images and visualizations that help students easily understand new and abstract concepts. The instructors also use ICT to show their students what awaits them (state- of -the- art technologies) in the real world of work so that learning becomes authentic.

It was also learned that instructors use ICT for the purpose of supporting classroom instruction through *demonstrations*. The participants reflected that they use ICT to demonstrate various experiments and procedures that cannot be carried out in the actual classroom or in the laboratory due to, e.g. shortage of resources. As said by instructors, demonstration enables the concretization of ideas and processes so that students can easily understand the lesson.

6.2. Preparation and storage of teaching materials

The instructors reported five different themes regarding teaching materials that they (and their students) use to reach course objectives. It regards searching, compiling, writing, organizing, and storing teaching resources such as electronic books, videos, presentation slides, and readers (handouts). This type of educational use of ICT is mainly performed outside classrooms as a part of the preparation for classroom instruction. Instructors in the three universities comparably use the internet and computers to prepare, organize and store multimedia resources such as texts, videos and animations that support teaching and learning. The basic themes under the preparation and storage of teaching materials category and their respective examples of quotations are presented in Table **2**.

According to the participants, instructors use ICT to prepare *lecture notes* that consist of key points of the lesson to be used by the students. The instructors reflected that they use ICT to prepare notes or handouts mainly for the theoretical parts of the courses to support classroom presentations so that students can read them before class. In addition, instructors use ICT to *prepare presentation slides* for classroom lectures.

Apart from the preparation of teaching materials, the instructors use ICT, particularly the internet, to search for *books* they and their students can use as a resource. According to the

participants, adequate and up-to-date books are hardly available in hard copy in their libraries. Hence, they use the internet to search for books in soft copy. The instructors attach the advantages of portability, storage, and easy retrieval to the use of electronic books.

Table 2

ICT use for materials preparation and storage

Basic theme	Frequency	Example of quotations
Lecture notes	18 (86%)	B5: *"For the lecture part we use ICT to prepare different notes or handouts for the students."* A7: *"we use ICT for preparation of teaching materials, lecture notes."*
Prepare presentation slides	17 (81%)	C6: *"We use ICT particularly computers to prepare PowerPoint for classroom lectures and presentations."* A3: "*Also we use computers for the preparation of lesson materials, like PowerPoint*"
Books	15 (71%)	A6: *"[…] I browse different books in order to support my lesson."* B5: "*I use ICT to download latest books that are related to my courses."* C1:"*The other one is unavailability of books. If hard copy books are available in the library in the required amount I may not use ICT that much."*
Software	6 (29%)	C6: *"…different analysis and designs in engineering demands us to run various software. We download this software from the internet."*
Storage	4 (19%)	A3: *"I am using these materials (computers) to store huge amount of data and teaching."* B4:"*storage of teaching resources in hardcopy takes much physical space but in softcopy storage of videos and texts on one's computer takes very little space."*

Instructors also use ICT to search for *software* that they can use for educational purposes. According to the participants, ICT, mainly the internet, is a vital source for searching educational software such as AUTOCAD, GIS, IRIDAS, SPSS, and SAS, which support practical lessons in and outside classrooms.

Furthermore, instructors use ICT for *storage* purposes. Storage refers to the use of ICT by instructors to create a repository of teaching resources. The instructors reflected that they use ICT to create a personal digital library for the different courses they teach and to keep a record of students' data. The instructors use ICT for storing huge amounts of data which would be difficult to do otherwise.

6.3. Assessment

Assessing students' learning progress is another purpose for which instructors use ICT. It comprises of ICT use for grading and assessment purposes (see Table 3).

Table 3

ICT use for assessment

Basic theme	Frequency	Example of quotations
Grading	19 (90%)	C4: *"… we have started submitting students' grades using online systems."* B4:"*Here in our university we have online grading system. This grading system saved us from many paper works that takes us long time to process students' grade manually."*
Assessment	4 (19%)	B5: *"Another use of ICT is for processing students' learning assessment data […].we collect and store data regarding students' progressive assessment."* C1: "*I also use computer to prepare exams and tests for the students and my own preparation*."

The participating instructors use ICT for *grading* purposes. Participants indicated that they use ICT for processing and submitting students' grades online. In the three universities, there is an online grading system that instructors use to submit students' grades. Using an online grading system enables instructors to become more efficient, i.e., it enables them to process grades quickly and reduce errors they may make when doing it manually.

In addition, the participants stated that they use ICT to *assess* and record data regarding the students' learning process. This comprises the use of ICT for preparing examinations and analyzing and submitting students' grades. The participants also mentioned that they use computers to write exams and assignments for students. Most of the learning assessment activities in the three universities are supported with ICT.

6.4. Professional development

Professional development refers to using ICT by instructors to improve their professional knowledge, skills, and expertise. As depicted in Table 4, it encompasses *self-development* and *scholastic activities*. Unlike professional development interventions that universities organize, *self-development* refers to a type of professional development in which instructors themselves take the initiative. It involves instructors' use of ICT to remain up-to-date with contemporary developments in their respective fields of study. The participants perceive that they need to stay abreast professionally and that, for this reason, they use ICT as a tool to access relevant resources. This implies that ICT has become a crucial instrument for instructors to keep themselves informed about developments regarding the subjects they teach and the pedagogy they adopt.

Scholastic activities refer to the use of ICT by instructors for research activities, including literature search and research findings dissemination. It is considered a professional

development activity because when instructors are involved in individual and collaborative research areas of their professional interest, they develop professional expertise. The participants discussed that ICT, particularly the internet, is an irreplaceable resource of information for instructors to be involved in scholastic activities (search literature, identify appropriate journals for publication).

Table 4

ICT use for professional development

Basic theme	Frequency	Example of quotations
Self-development	12 (57%)	A4*: "...I feel I have to update myself as a teacher […] I feel updated when I read something on internet or when I use my computer for searching information."* C2:"*We use ICT in order to gain new insight or to gain new concepts for what we are going to teach the students."* B1: *"...But teachers need to train themselves by watching different videos online."*
Scholastic activities	8 (38%)	C7: *"... we use ICT to search and collect resources for research undertaking."* A7*: "Without ICT it is difficult to conduct research*."

Besides looking for scientific resources, instructors also use ICT to share their research findings with others. Instructors mostly publish their research findings in open access journals so that they are accessible without fees. This implies that research undertaking is linked to the instructors' regular task of teaching and the role of ICT is crucial in facilitating instructors' involvement in research. The internet in particular is a major source of input (e.g., journal articles) required for developing research proposals and disseminating research findings to the scientific community and other beneficiaries.

6.5. Information and resource exchange

This category refers to exchanging information and sharing resources between instructors and students, and among instructors themselves on matters pertinent to courses they teach. As shown in Table 5, it comprises *communication* and *resource sharing*. From the FGs it was learned that instructors use ICT for the purpose of *communication* as well. The participants indicated that e-mail is a predominant means of communication among instructors and students on education matters.

In addition to the use of ICT for communication purposes, the instructors stated that they use ICT for *sharing* teaching and learning resources among colleagues. For example, the participants mentioned that they create group accounts in Google and Microsoft and share

various course materials that can be used for teaching. There is also evidence from the discussions that instructors use LMS like MOODLE to share resources with the students.

Table 5

ICT use for information and resource exchange

Basic theme	Frequency	Example of quotations
Communication	10 (48%)	B8*: "... We have institutional e-mail which we use for any official communication. Using e-mail has replaced previous paper based communication."* C7*: "If I do not have materials in hard copy on what I teach I can receive the necessary resources from colleagues teaching in other universities like Jimma and Wollega universities through e-mail."*
Resource sharing	8 (38%)	A2: *"In our department we do have a shared Google account where we usually upload certain materials and colleagues could download and use those materials."* C4:"*The other one is material sharing. In our department, we have made digital resources to be stored in one place and used by all teachers and students for teaching and learning purpose."*

7. Discussion

Instructors' educational use of ICT is driven by the university's focus on improved access to digital (online) resources and fair use of technology. Their usage may include course materials preparation and storage, course facilitation, assessment, professional development, and information exchange and resource sharing. This usage is consistent with the findings of van Braak, Tondeur and Valcke (2004) that label teachers' main ICT use as supportive and classroom use. Supportive use of ICT includes the use of ICT for student evaluation, preparing supplementary reading materials, and keeping track of pupils' learning progress, whereas ICT use for such things as a demonstration, drill and practice, instruction, and differentiation refers to classroom use of ICT (van Braak et al., 2004). The basic themes belonging to *course facilitation* conceptually fit into the *classroom use* of ICT proposed by van Braak et al. (2004) as they both refer to the use of ICT for similar purposes (e.g., flashing information in the classrooms using beamers). We argue that *course facilitation* is more appropriate as a theme than *classroom ICT use* when it comes to the educational use of ICT because *classroom use* denotes more of where to use ICT while *course facilitation* focuses more on the specific purpose for which ICT is used in teaching and learning. In addition, the

basic themes *material preparation* and *assessment* conceptually coincide with supportive ICT use of van Braak et al. (2004). Compared to van Braak et al.'s (2004) classification, ours is broader as it adds the *professional development* and *information and resource sharing* themes that are not a part of van Braak et al.'s (2004) ICT use classification. Also, Meneses, Fàbregues, Rodríguez-Gómez and Ion (2012) classify ICT use as supportive and managerial use. Managerial use of ICT refers to ICT use for communication and interaction whereas supportive internet use refers to using the internet to prepare course materials that support classroom instruction (Meneses et al., 2012). Our classification of ICT use also overlaps with Meneses et al.'s (2012) classification in that the *material preparation* and *assessment* themes that emerged from our study conceptually fit into supportive ICT use of Meneses et al. (2012). In addition, the *information and resource sharing* theme emerged from our study partially fit into managerial ICT use proposed by Meneses et al. (2012) as both involve the use of ICT for information and resource exchange. However, we extended this category by including the use of ICT for resource sharing. Also, compared to Meneses et al.'s (2012) ICT use classification, ours is broader as it extends their classification by adding the *course facilitation* and *professional development* elements.

Supportive ICT use, as coined by van Braak et al. (2004) and Meneses et al. (2012) is a very broad concept and includes several distinctive educational uses of ICT outside the classroom, including material preparation, professional development and assessment, which are emerging as independent organizing themes in our study. As we claimed in the result part, these themes have their own distinctive characteristics and hence need not to be put in one basket (supportive ICT use). For example, using ICT for *material preparation* and *professional development* are different functions when seen from teaching and learning perspective. The former focuses on organizing teaching and learning tools so that students can learn from the materials at any time without much dependence on the instructors. The latter involves what the instructors actually perform with ICT to keep themselves updated with recent development in the areas of pedagogy, technology, and content of subjects they teach. The concept of *supportive ICT use,* thus, is vast and less informative as ICT is generally used as a supportive tool in all forms of its use in teaching and learning.

In sum, this study's evidence supports findings of previous studies (e.g., Meneses et al., 2012; Ricardo-Barreto, Molinares, Llinás, Santodomíngo, Acevedo, Rodríguez, & Villa, 2020; Van Braak et al., 2004). Furthermore, the study's findings extend previous ICT use classifications by adding *professional development* and *assessment* elements. Our ICT use classification is, thus, more systematic (we recognized the distinctive features of educational

ICT use) and comprehensive (we extended ICT use classification by previous studies).

From the analysis, substantial evidence was generated that support the notion that instructors predominantly use ICT to support the existing teacher-centered classroom practices. In the three universities studied, the sampled instructors stated that they usually use presentation slides to facilitate teaching-learning practices, particularly classroom lectures. They seem to incline towards emergent users. This means they use ICT in the way it brings no substantial change in teaching and learning compared to the non-users (Choeda, Penjor, Dukpa, & Zander, 2016). This finding corroborates findings of studies in HE in some developed countries such as Japan (Aoki, 2010) and Germany (Bond, Marín, Dolch, Bedenlier & Zawacki-richter, 2018) where ICT in general and E-learning in particular, are used to support the prevailing teacher-centered classroom practices rather than to transform teaching and learning. A number of scholars discovered the same finding in countries such as Belgium and proposed actions for transformation (e.g. Goeman, 2008). However, transformative ICT use is yet to be realized. Moreover, the comparable use of ICT by instructors in the three universities implies that generational differences between Ethiopian universities (year of establishment, university size, and infrastructure) have no substantial impact on how they use ICT.

In general, we explored various educational ICT uses that supplement each other and ultimately facilitate the attainment of goals in teaching and learning. A*dequate preparation*, which is fundamental for instructors' effective classroom performance, is contingent upon the extent to which instructors have access to various multimedia resources. Whetten (2007) stated that a well-designed course demands adequate preparation. As described earlier, ICT is a crucial tool for preparing teaching resources at universities. Moreover, *students' assessment*, which is an integral part of learning-centered course design (see Whetten, 2007) is another aspect of educational use of ICT as reported by the participant instructors.

Furthermore, *communication* between students and instructors plays a pivotal role in learning achievement (Ndongko & Agu, 2014) and the use of ICT enables efficient communication. Teachers' collaboration in the form of resources and experience sharing positively influences their teaching performance as it allows them to work together to solve educational problems they encounter (Murray, 2010; Shakenova, 2017). The use of ICT assists electronic collaboration among teachers (one strategy of *professional development)*. Self-initiated *professional development* activities in which instructors assume major responsibility for their own professional empowerment are also crucial to improve their pedagogical skills (Simegn, 2014). As reported by the participants, ICT is a key tool by which

instructors keep themselves updated with recent developments. Besides, developing a personal *repository of course resources* allows instructors to retrieve and use electronic resources when needed easily. It also allows efficient sharing of resources among instructors. As reported by the participants, instructors use ICT as it enables effective and efficient storage of e-resources that can help them to support classroom instruction. It is, therefore, evident in this study that ICT is used to accomplish various teaching-learning activities in universities under scrutiny.

8. Conclusions

The results from this study indicate that instructors in the participating universities use ICT primarily to support the existing teacher-centered pedagogy in a non-transformative way. ICT use in these universities hardly facilitates active, collaborative and creative learning, which are considered to contribute to improved HE quality. Contrary to what was expected, this study's findings are similar to what was supported about educational ICT use at universities in some developed countries (e.g. Goeman, 2008). This comparability of ICT use patterns at universities in developed and developing countries might imply that differences in the level of economic development do not necessarily lead to differences in the status of affairs or the advancement of educational ICT usage in HE.

One might conclude that ICT usage in Ethiopian HE mimics to address educational problems that are observed in developed countries, independently from (considerations about) the developing countries' context. Future studies could, therefore, focus on an integrated examination of national, institutional, curricular and didactic elements to ensure contextualized and transformative use of ICT. This may involve the investigation of critical conditions and pre-conditions for transformative ICT use and the development of a customized model that informs such an ICT use practice in developing countries. The classification of ICT usage that is presented in this study may aid in this regard.

Annex 1

Profile of the participants

		Frequency	Percentage
Level of education	Bachelor Degree	1	4.8%
	Master's Degree	18	85.7
	Ph.D	2	9.5%
Academic rank	Lecturer	15	71.4%
	Assistant Professor	6	28.6%
	Associate Professor	0	-
	Professor	0	-
Service year	0-5	10	47.6%
	6-10	8	38%
	11-15	2	9.5%
	20 and above	1	4.8%

Annex 2

Summary of instructors' educational ICT use in the three universities

Organizing themes	University A	University B	University C
Course facilitation	Demonstration in a classroom, display information and deliver class through presentation slides.	Classroom presentation using PowerPoint, display and demonstrate various lessons, visualize illustrations, and display pictures.	(Video or visual aids) for classroom instruction, classroom presentation and facilitation, display different pictures and animations, demonstrate lab activities, and analysis and designs in engineering.
Material preparation and storage	Preparation of lecture note, storage of data, download educational software, prepare lesson materials (in excel, word etc.), search additional information pertinent to courses they teach and download books	Preparation of handouts and lecture notes, different information pertinent to course they teach, store learning assessment data, preparation of presentation slides, access and assemble teaching resources, download software applications and books	preparation of teaching materials , handout, lesson plan, presentation slides, software and searching different electronic books online
Assessment	Preparation of grade and submit final results of students via SRS (registration software).	Collection and processing of learning assessment data-continuous assessment record and keep students' assessment data on SRS.	feeding and submitting students grades online using SRS,
Professional development	Research undertaking, update own self with recent developments, disseminate research findings-publications, self-learning through YouTube.	Gaining new insights through internet, searching new information regarding courses they teach and updating themselves academically	Updating themselves with emerging innovation , developing own capacity through online self-learning, collecting resources for research undertaking,
Information and resource sharing	Dissemination of teaching and learning resources to students, putting resources on learning platform for students, share teaching resources through Google account.	Communicating with students and teachers in and outside the university.	communicating with students and teachers, assignment of students on course activities, sharing digital teaching resources, sharing resources with colleagues in other universities

Chapter Three: Determinants of Instructors' Educational ICT Use in Ethiopian Higher Education

Abstract

ICT can address concerns about access and quality of higher education in developing countries like Ethiopia. The crucial role of ICT in education has become more evident than ever during the COVID 19 crisis. Despite its role in addressing educational quality and access issues, evidence about the educational use of ICT in developing countries is scarce. Many previous studies on determinants of educational ICT focus on higher education in developed countries, while it remains unclear whether existing models explain ICT use by instructors in developing countries. This study reports the findings of a qualitative study conducted in three public universities of Ethiopia in order to elaborate determinants of instructors' educational use of ICT. First, it presents a conceptual framework of factors that explain instructors' ICT use based on literature. Second, based on empirical evidence collected from instructors, it assesses their experiences and opinions in relation to the proposed framework components. In-depth data were collected through focus group discussions from twenty-one instructors. The data were analyzed thematically with ATLAS.ti software. The results confirmed that the institutional, individual and infrastructure-related determinants of the framework are perceived to be relevant in determining instructors' ICT use. Moreover, the study revealed the necessity of extending the proposed framework through aspects of management support, course-related factors, students' ICT competence and access to ICT infrastructure as new determinants of instructors' educational ICT use. Implications for theory-building are discussed and follow-up research is proposed.

Key Words ICT use determinants, higher education, developing countries

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1. Introduction

Higher Education (HE) in developing countries experiences a problem of quality. This is attributed to poor physical infrastructure, shortage of qualified staff, alongside a mismatch between curricula and needs of the labor market and limited hands-on experience of students (Mohamedbhai, 2014). Ethiopia, a country in Africa, is not an exception to this problem. Its Ministry of Education indicates that the quality of HE is suffering from large class sizes, high proportions of inexperienced teachers, teacher-dominated pedagogy and curricula that hardly respond to local needs (Ministry of Education [MoE], 2017). Although ICT is not a panacea for all difficulties in HE and for students' learning (OECD, 2015), it may address some of the challenges of HE in developing countries. ICT use may facilitate the implementation of teaching approaches that promote students' engagement, collaboration and interaction (Shelomovska, Sorokina & Romanyukha, 2016; Talebian, Mohammadi & Rezvanfar, 2014), as well as create unrestricted access to relevant teaching and learning resources in HE (Shelomovska et al., 2016).

Despite widespread understanding about the benefits of ICT in teaching and learning, and increased investment in ICT (Kozma & Vota, 2014), scholars argue that it is not used satisfactorily for teaching and learning purposes in HE in developing countries in general (Zander 2016; Barakabitze et al., 2019), and in Ethiopia in particular (Alemu, 2015; MoE, 2017). This was also noticed in the first week of the COVID-19 outbreak in Ethiopia when the Ministry of Science and Higher Education directed all higher education institutions (HEIs) to implement online classes but many of the HEIs, including those with a decent ICT infrastructure, failed to do so. Studies conducted in the context of HE in developing countries focused on identifying determinants of students' ICT use (Macharia & Pelser, 2014) and its impact on learning (Rowe, Frantz & Bozalek, 2012; Bernard, Borokhovski, Schmid, Tamim & Abrami, 2014). However, limited attention is being paid to instructors; their role and voice are under-represented in these studies (Bervell & Umar, 2017). Ergado, Desta and Mehta (2021), for example, in their recent study of barriers for ICT implementation in Ethiopian HE institutions collected data from HE leaders, students, experts in the ministry of science and HE, and international organization (e.g., World bank group in Ethiopia) excluding HE instructors. The perspectives of instructors regarding ICT use need to be examined as the decision to use technology in teaching and learning mainly rests on instructors (Howard & Mozejko, 2015). Besides, when ICT initiatives are introduced in HEIs, it is the instructors who first experience the pressure to use ICT (Teo, 2011) and also play a role in its adoption

(Chang, 2010). Furthermore, previous studies of ICT use determinants in HE focused on listing and categorizing barriers (Ali, Uppal & Gulliver, 2018; Andersson & Grönlund, 2009). While the identification of generic determinants is important, policy makers in HE in developing countries also need to know if there are ICT use determinants which are unique to their specific contexts if they are to make informed decision. Given these considerations, and the contextual nature of determinants of ICT use (Lim, Ra, Chin & Wang, 2020), we assume the need for a profound study of factors that determine ICT uptake and sustained use in Ethiopian HE. In so doing, we first propose a conceptual framework that consists of individual, institutional and infrastructure-related determinants of instructors' ICT use based on available literature. Afterwards, we assess the proposed determinants based on qualitative evidence generated from instructors.

2. Research context

Ethiopia, as has been the case in other countries, has its own context that might have implications for ICT use in HE. As a result of the massification of HE in Ethiopia, its quality seems to be compromised. In the Ethiopian HE sector issues of access, relevance, equity and quality are the major challenges that need to be addressed during the implementation period (2018-2030) of the current education sector development roadmap (MOE, 2017). ICT is a relatively new phenomenon in Ethiopia (Alemu, 2017) and its penetration in the education sector has been slow (Tibebu, Bandyopadhyay & Negash, 2009). The Ethiopian government has embarked on ICT-enabled transformation in all sectors including education to enhance performance and deliver a better public service with the ultimate goal of improving the lives of its citizens (Lixi & Dahan, 2014). In its fifth Education Sector Development program (ESDP V) 2015/2016-2019/2020 the government plans the expansion of ICT integration in order to transform the quality of teaching at all levels of education. The plan stipulates that, during the implementation period of ESDP V, an ICT in education policy will be ratified; ICT and internet connections will be provided to all universities; pedagogy, technology and content will be integrated; ICT will be mainstreamed across core subjects, digital contents will be developed, and Learning Management Systems (LMS) will be in place at all levels of education to support teaching and learning activities (MoE, 2016). On the basis that the use of ICT is a key tool for addressing the multifaceted problems of Ethiopian HE, the government not only highlighted the need to transform HE campus environments via ICT but also engaged in increased investment in ICT. However, ICT is underutilized in Ethiopian HE (Alemu,

2015; Ergado, 2019; Tibebu, Bandyopadhyay & Negash, 2009), and yet to benefit from its use.

3. Towards a conceptual framework

3.1. ICT use

In the context of this study, ICT use refers to professional use of ICT (for teaching and learning activities) which comprises supportive use of ICT (e.g. searching supplementary materials online) (Mama & Hennessy, 2013), the administrative and managerial use of ICT (e.g., using e-mail to communicate with colleagues and students) (Mama & Hennessy, 2013) and classroom use of ICT (e.g., using ICT as a tool for demonstrations in the classroom)(Van Braak et al., 2004).

3.2. Determinants of instructors' ICT use

We capitalized on available reviews and other empirical studies to elaborate on a conceptual framework for determinants of instructors' ICT use in the HE of Ethiopia. It includes three major categories, namely: institutional characteristics, infrastructure and individual characteristics.

3.2.1. Institutional characteristics

Institutional characteristics refer to determinants that are not directly attributed to individual ICT users but systematically influence ICT use (Ali et al., 2018). *ICT vision* relates to universities' aspiration regarding the role of ICT in teaching and learning (Zhu, 2015). Institutional ICT vision is a key for ICT use (Goeman, 2008; Zhu, 2015) as it gives a general framework for strategic and operational planning and decisions regarding the allocation of required resources (Salik & Zhiyong, 2014). Research evidence shows that the lack of ICT vision is one of the critical determinants of instructors' ICT use in HE (Barakabitze et al., 2019; Raphael & Mtebe, 2016; Rana & Rana, 2020).

The *ICT plan* refers to a document prepared by universities and contains the overall philosophy and goals of ICT use in education, technical and infrastructural specification, strategies of implementation and monitoring and evaluation techniques (Vanderlinde, van Braak, & Dexter, 2012). One of the potential explanations for differences between educational institutions in terms of the level of ICT integration is the presence of an ICT plan (Baylor & Ritchie, 2002). For HE in developing countries, where the place of ICT in education is not clearly figured out and the institutions operate with the meager financial resources they receive from government, the role of an ICT plan is critical.

Critical for ICT uptake by instructors are *professional development* initiatives which focus on both technology and pedagogy (Goeman, 2008; Kopcha, 2012; Teo, Huang & Hoi, 2018). These can be organized as face-to-face trainings, online tutorials, workshops or seminars that aim at improving instructors' ICT competence (Al-Busaidi & Al-Shihi, 2012). As new technological tools and pedagogies are introduced, instructors need professional development interventions that not only equip them with the required competencies to use ICT but also help them develop a positive attitude (Inamorato dos Santos, Gausas, Mackeviciute, Jotautyte & Martinaitis, 2019).

Technical support, which refers to expertise support provided to instructors by specialized personnel skilled in using technology for instruction (Moses, Bakar, Mahmud & Wong, 2012) is another ICT use determinant. Technical support may cover providing helpdesks and online support service (Teo, 2010) including access, operation and troubleshooting of hardware, software and network resources (Dexter et al., 2002). While working with technology instructors may face some technical issues which are beyond their capability. Also, it is not uncommon for instructors to experience confusion, intimidation and frustration when they are required by their institution to adopt new technology in the teaching-learning activities (Mouakket & Bettayeb, 2015). In such circumstances, availability of on-time technical support is important to fix technical issues (Aldheleai et al., 2019) and enhance instructors' willingness to adopt ICT (Rizana, Hediyanto, Ramadhan, & Kurniawati, 2020). In the absence of adequate technical support instructors may not be motivated to use technology because they do not want to take risks of failing with using technologies (Buabeng-Andoh, 2012a).This may imply that an efficient and effective ICT users' support system needs to be in place in universities so that instructors would be adequately supported. An ICT technical support service is, therefore, crucial as it may boost instructors' confidence for integrating ICT into their teaching (Martins & Nunes, 2016). Yet, it is frequently reported to be among the impediments to ICT use (Ali et al., 2018; Bervell & Umar, 2017; Kaliisa & Picard, 2017; Wingo, Ivankova & Moss, 2017).

3.2.2. Infrastructure

The second category of determinants refers to ICT infrastructure which encompasses ICT hardware and software, internet and electricity. Several reviews reported infrastructure to be among the major determinants of ICT use (Ali et al., 2018) in developing countries (Barakabitze et al., 2019). The availability and accessibility of ICT infrastructure are fundamental requirements of ICT use in education. Lack of ICT infrastructure may cause

frustration and discouragement among instructors and, eventually, result in poor ICT use. Many recent studies stress that infrastructure matter when it comes to ICT use (e.g., Asuman & Clement, 2018; Barakabitze et al., 2019; Bridget, 2016).

3.2.3. Individual characteristics

The third category refers to attributes of instructors. We consider instructors' ICT attitude and ICT use competence in our framework. Attitude, which refers to instructors' liking or disliking for using ICT in education, determines instructors' ICT use. Teachers tend to integrate technology into their teaching when they have a positive attitude towards it. Supporting this claim, several studies showed that teachers' attitude towards ICT is among the major determinants of ICT use (Ali et al., 2018; Goeman, 2008; Kaliisa & Picard, 2017; Rohayani, Kurniabudi & Sharipuddin, 2015). Likewise, ICT competence is a prominent influencer of ICT use (Bervell & Umar, 2017; Rohayani et al., 2015). It denotes the instructors' knowledge and skills in using ICT in the teaching-learning process (Vanderlinde, Aesaert & van Braak, 2014). ICTs have only recently been introduced into the universities of many developing countries. Hence, many instructors may have no or little exposure to work with various technological tools in education which might imply limited ICT competence. Instructors' ICT competence remains one of the challenges to ICT integration in HE in Africa (Barakabitze et al., 2019).

4. Method

In this study, the researchers intended to assess determinants in the aforementioned framework based on a field study among HE instructors in Ethiopia. We employed a qualitative research approach because we wanted to gain a more profound understanding based on the instructors' knowledge and viewpoints (Creswell, 2012; Flick, 2018). In this regard, qualitative research is appropriate for collecting and analyzing in-depth information from participants in different university settings (Ary,Jacobs, Irvine & Walker, 2018).

4.1. Context and sampling

Based on their year of establishment and size in terms of student population, Ethiopian universities are categorized into three generations (groups): established, emerging and new. Established universities are those founded between 1950 and 2000, have a relatively larger student and teacher population and better ICT infrastructure when compared to emerging and new universities. Emerging universities are relatively younger universities (established in 2010 and 2011) with a relatively smaller number of students and teachers and with undeveloped ICT infrastructure. New universities are those established between 2006 and

2009 and are in the middle between established and emerging universities in terms of student population and ICT infrastructure (Geda, 2014). Accordingly, the researchers considered three universities as a sample (one from each category). We used a snowball sampling technique (Creswell, 2012; Patton, 1990) to select participants who were considered as information rich, willing and interested in sharing their views of ICT use determinants from different faculties at three different universities of Ethiopia. The participants were identified in such a way that first teachers whom the researchers know were contacted and the title and purpose of the study were explained to them. Thereafter, they were asked to mention instructors who might be interested and volunteer to discuss determinants of instructors' educational ICT use and have a teaching experience of at least two years. At each university the instructors whom we first contacted recommended us two or three instructors whom we should contact in each of the faculties/colleges. Accordingly, we met these instructors on the phone and explained the purpose for which we needed them. If the first person we contacted in the faculty was volunteering, we would stop there and go further with another faculty/college. If the person whom we first contacted was not volunteering, we would go for the second person on the list. We repeated this procedure till we secured one participant from each faculty/college in the three universities. Twenty-one instructors, with varying disciplinary backgrounds (health science, social sciences, natural sciences, engineering, agriculture science, and business and economics) and teaching experience between 2 and 20 years participated in one out of three focus group discussions (FGDs) (one for each university). About 85% or 18 instructors obtained a Master's diploma, 9.5%% (n= 2) a Doctoral degree and the remaining university staff held a bachelor's degree. The majority of the participants taught at undergraduate level.

4.2. Data collection

We collected information-rich data from university instructors through FGDs. We opted for this data collection procedure as we intended to generate data which is shaped by group interaction (Flick, 2018) and provides information that might be forgotten or repressed if collected by other methods such as an individual interview (Berg, 2001). Three face-to-face FGDs, each consisting of 6 to 8 participants, were conducted at the three universities at locations preferred by the participants and permitted by the universities. The moderator of the discussions did not reveal the theoretical framework to the participants. He rather encouraged them to freely discuss their experiences and opinions regarding what determinant their educational ICT use.

The FGDs had three sections. The first part was the introduction section in which the

FGD facilitator and the participants introduced themselves to each other and discussed the study objectives. The second section dealt with the discussion part whereby the participants reflected their views and perceptions based on questions posed by the facilitator. The last part of the FGD was devoted to the section whereby the facilitator summarized the main points, asked if the participants had any additional thoughts to share and acknowledged the group for participating. The FGDs began by acknowledging participants for their willingness to participate in the FGD. Then the moderator introduced himself and explained the purpose of the study. The researcher further read and explained the FGD consent content to the participants (all the participants did sign the consent form). The three FGDs started after having confirmed that the participants had no further queries and concerns. To his level best the facilitator attempted to probe the discussion and let all the participants actively engage by giving them an equal chance and controlling the dominance of few individuals. The discussions were led by guiding questions such as “What institutional factors do you think determine your ICT use? What instructors-related factors affect your ICT use? What infrastructure-related determinants affect your educational ICT use? What other factors do you think as determinants of your ICT use?" The duration of the FGDs ranged from 90 to 110 minutes and was audio recorded using a digital sound recorder to facilitate its transcription. The audio recorded data were stored on a computer. Each FGD was transcribed verbatim and sent back to the participants to ensure the reliability of the FGD data. More than half of the respondents provided feedback. After the participants checked the transcripts and confirmed their correctness, two researchers started analyzing the data.

4.3. Data analysis

The six steps of Creswell's (2012) approach guided the qualitative data analysis. First, the taped interviews were transcribed and digitalized by the principal investigator. Afterwards, the principal researcher and one colleague researcher coded one transcript, after which the coding schemes were discussed and one final scheme was established. The remaining transcriptions were coded accordingly (Syed & Nelson, 2015). The thematization process was conducted using ATLAS.ti software and involved the identification of basic, organizing and global themes. Formation of the basic themes was conducted inductively with strong reliance on the transcriptions. The theory-driven framework was used as a blueprint for defining categories and global themes: even so, a series of new themes emerged from the FGD data in an inductive manner (Armat, Assarroudi, Rad, Sharifi & Heydari, 2018). After

repeated coding, we identified fourteen basic themes that are categorized under four organizing themes to form one global theme (Attride-Stirling, 2001) (see Figure 1).

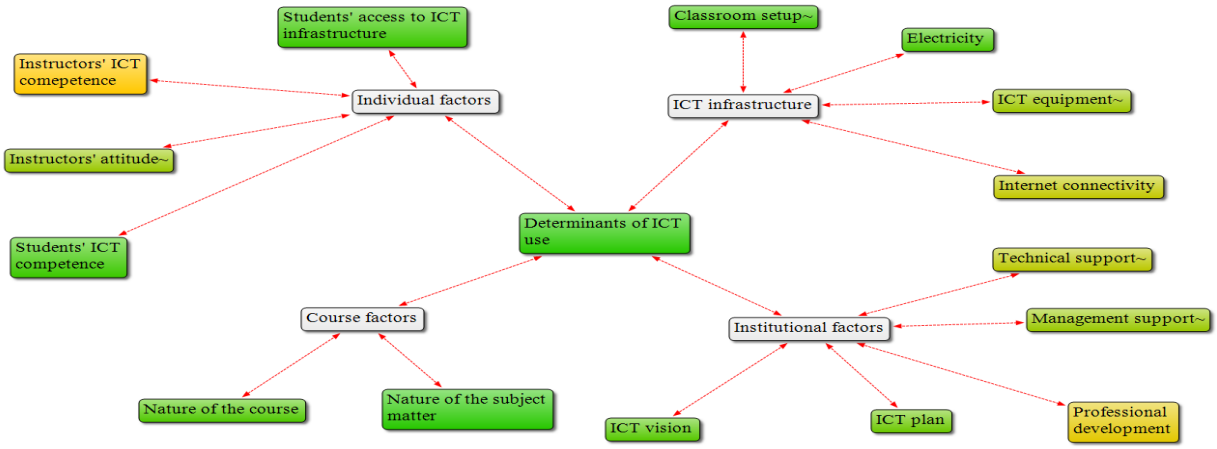

Figure 1: *Thematic networks of the emerging themes*

Descriptions of the themes are supported with sample quotes from participants because of their enriching character. To ensure anonymous reporting, the universities and instructors are represented by letters (A, B and C) and numbers respectively. We used square brackets to indicate the part of the transcript that has been omitted to focus on what is key for illustrating the findings.

5. Results

The results of our study indicated that institutional characteristics (ICT use vision, ICT plan, professional development, management support and technical support), individual characteristics (instructors' ICT competence and instructors' attitude, students' ICT competence and access to infrastructure) and infrastructure (internet, ICT equipment, electricity and classroom setup) are perceived by the instructors to be their ICT use determinants.

We further extended our initial framework to include five new themes which are labeled under the three existing and one new categorizing themes, namely: *management support* (institutional characteristics), *students' ICT use competence, students' access to infrastructure* (individual characteristics), *classroom setup* (infrastructure) *and course factors (*new category*).* The initial and emerging determinants are presented in Table 1 and discussed in the following sections.

Table 1

Overview of existing and emerging determinants of ICT use

Categories	Determinants	Exists and supported	Emerged (new)
Institutional	ICT vision	✓	-
	ICT Plan	✓	-
	Professional development	✓	-
	Management support	-	✓
	Technical support	✓	-
Infrastructure	Internet connectivity	✓	-
	ICT equipment	✓	-
	Electricity	✓	-
	Classroom setup	-	✓
Individual	Instructors' ICT competence	✓	-
	Instructors' ICT attitude	✓	-
	Students' ICT competence	-	✓
	Students' access to ICT infrastructure	-	✓
Course factors	Nature of the course	-	✓
	Nature of the subject matter		✓

5.1. Institutional characteristics

Institutional characteristics encompass *ICT vision*, *ICT plan*, *professional development* as well as *technical* and *management support*. Management support, which was not in the original framework but emerged from the analysis, was included in the institutional characteristics category. Each of the determinants in the institutional characteristics category is discussed in the upcoming sections.

Professional development

Professional development encompasses capacity building interventions organized by universities (awareness raising, counseling and skill development trainings) and instructors' self-training (from videos and continuous ICT use practice). It was learned from the discussion that since a majority of instructors do not have the required competence, professional development interventions that are geared towards teachers' technical and educational ICT use skills need to be in place if ICT has to be used. Even those instructors who were previously involved in ICT training complained that the training they received is inadequate and that, consequently, they need further training to use ICT in an innovative manner.

Table 2

Instructors' perception of institutional determinants

Theme	Examples of quotations
Professional development	B3*: "We need capacity building training on how to utilize ICT in a better way."*
	A5*: "I have to know how to operate my computers; I have to know how to update applications I use for classroom education. Thus, digital literacy training is important."*
	A1*:"But now, to train in software, you only need to go to YouTube and get ad hoc trial training."*
Technical support	A2*: "If I have a trouble with my computer, ICT people should help me to get through."*
	C2: "We have only few skilled man powers on ICT professionals […] the existing ones lack commitment to support and they sometimes seek incentives from teachers."
Management support	C2*: "Emphasis given by top management is very poor, top management is unwilling to listen to our basics and common ICT infrastructure questions."*
	B1*: "I have not seen any training, any workshop on ICT use. We have to see this. The University management has to create such opportunities for instructors."*
ICT plan	C5*: "Compared to other sectors, universities have no serious budget problem. But the budget is not properly utilized […] the problem is that universities are not planning to improve the different ICT infrastructure and internet speed."*
	B4: *"Office secretariats have better access to internet than computer teachers […]. There are also people in the administration whose work does not demand the use of computers but given lap top by the university while teachers do not have it. Hence, the university should identify priority."*
ICT vision	A4*: "Of course, we know university A aspires to be one of the leading higher education institutions in the world. But, if you go down, you do not find details of how this could be possible. For example, we do not know the vision of ICT after 10 years. What if it is put in detail?"*
	A3*:"The university needs to have a boss who has a vision and plan in the future."*

The participants asked for continuous training that begins with basic ICT skills and progresses towards the more advanced uses of ICT with a focus on its integration into teaching and learning. They, however, reported that ICT use training is yet to become an integral part of instructors' professional development program in their universities. There were also participants who reflected that, though training is needed, instructors should not always wait for their university to arrange trainings. They should use their own initiative to develop their skill at using ICT.

Technological support

The instructors stressed the need to monitor ICT use in the university in order to realize its efficient use. It was documented during the discussions that even the existing meager ICT infrastructure including the internet are misused (mostly for entertainment) due to the absence of an adequate monitoring system.

In additions, though instructors were in need of orientation and technical support, they received little support from the ICT office as, according to the instructors, the so called "ICT experts" had neither the skill nor commitment to support instructors. Moreover, ICT technical support staff members were not available when instructors needed them. Furthermore, it seems that the technical support staff members seek undeserved incentives from instructors to perform their regular duty of providing support. Instructors usually receive support after much pleading and sometimes go to commercial computer shops in the town and pay to get their computers fixed.

Management Support

Management support mainly involves resources (ICT infrastructure) provision and funding for capacity building trainings necessary for ICT uptake in education. It was widely discussed by participants as one of the determinants of instructors' educational use of ICT. The participants stated that the university management needs to be in the driving seat if ICT has to be used in education. Besides, the role of university management in organizing skills development training was underscored by the participants.

Though instructors expect much from the university management, it does not seem they were satisfied with the support they received. This is manifested through the universities' management unwillingness to support educational ICT use initiatives and unresponsiveness to ICT use-related requirements. The participants perceived that such unwillingness and unresponsiveness are due to poor competence and understanding of the benefits of ICT in education by the universities' management body. Besides, the high turnover of the universities' management is another challenge as most of them are removed from their position without having sufficient time to implement their plan.

ICT plan

The participants indicated that, in the universities, there were multiple priorities that compete for the meager resources. The universities, therefore, need to have a specific

ICT plan that rationalizes the allocation of resources for educational ICT use. For the participants, having an ICT plan helps to efficiently utilize the existing meager resources. Regarding the priority issue, the instructors complained that, currently, ICT is more accessible to administrative staff than to instructors which mean that academics are given less attention when it comes to ICT infrastructure. It seems that the instructors attribute some challenges in ICT use such as financing and shortage of infrastructure to poor planning.

ICT vision

As stated by the participants, the existence of an ICT vision in the universities can influence instructors' educational use of ICT. It is essential for instructors to know what their university desires to realize by using ICT. For this to happen, it is decisive to have visionary leaders. Instructors desire to be aware of what their university thinks and needs to achieve in the areas of teaching and learning by using ICT so that they know what is expected of them and work to their fullest potential.

5.2. Infrastructure

Infrastructure comprises internet connectivity, ICT equipment, electricity, and classroom set-up (Table 3).

Internet connectivity

Internet was widely shared among the participants as a critical determinant of ICT use. Without internet, ICT use is very limited. The participants stated that the availability, accessibility and capacity of internet are challenges in the universities studied. Moreover, where internet is accessible, the signal strength was so weak that they had to stay in the office for long hours to search teaching and learning resources. Limited access to internet is attributed to weak management commitment and restrictions from the government preventing access to relevant websites due to political reasons.

ICT equipment

ICT equipment mainly encompasses computers and LCDs. The availability, accessibility, functionality and processing capacity of computers were also mentioned by the participants as determining factor for instructors' ICT use. There was a shortage of computers in the universities and, hence, only a few instructors had their own PCs. The instructors mentioned that though they needed to have high capacity computers, they often received computers and laptops having low processing capacity. It was also evident from the

discussions that some ICT equipment is dysfunctional due to misuse by instructors and poor maintenance services.

Electricity

Electricity is another basic infrastructural component that determines ICT use. Participants stated that their ICT use is mainly contingent upon availability of electricity. From the FGDs, it became clear that instructors had been challenged when their class was interrupted while using ICT because of a sudden electricity disruption.

Classroom set-up

The participants stated that the majority of classrooms were not convenient for ICT use. Large class size, inappropriately designed halls, and poorly installed electrical and internet networks were some of the challenges in relation to classroom setup.

Table 3

Instructors' perception of infrastructure

Theme	Examples of quotations
Internet connectivity	A3*:"Internet is the most important factor determining the use of ICT for learning and teaching process."*
	C1*: "I do not have access to internet all the time."*
	A5:"Internet speed is important. You can sit in your office the whole day without browsing what you want
ICT equipment	*C6: "Surprisingly, for a department that has thirty teachers, the university gave only one computer."*
	A5:*""The other one is shortage of computers with high capacity […] We often receive computers with low processing capacity."*
	C5: *"There are ICT resources which are not functioning due to lack of qualified ICT experts. Printers and computers are not functional due to absence of maintenance."*
Electricity	B1*:"The first thing is interruption of electric power. The voltage is low to run the available computers for teaching learning process."*
Classroom setup	*C2: "The first thing is the classroom design; the sitting arrangement is not convenient. The class is not suitable for LCD usage because the sitting arrangement is not in the proper manner."*

In sum, participants in the three universities highlighted the decisive role of ICT infrastructure in order to ensure ICT use in education. However, they complained that shortages, accessibility and limited capacity of ICT infrastructure affected the enhanced use of ICT in the universities.

5.3. Individual characteristics

The findings of this study showed that both instructors' and students' characteristics (a new determinant which emerged from the data analysis though it was beyond the scope of the study) determined ICT use.

Instructors' ICT attitude

The participants expressed that an attitude determines instructors' ICT use. Conversely, ICT attitude is also determined by ICT use. A positive attitude is the result of interest in and continuous use of ICT. It was indicated during the discussion that when a person stays away from using computers, he/she may be discouraged from using them. This situation may eventually result in rejecting the technology altogether.

Instructors' ICT competences

ICT competences encompass both technical ICT use and skills to integrate ICT into teaching. Participants expressed that instructors' know-how determines their ICT use. The instructors explained that they have limited knowledge and skills (which they developed through self-learning) in using ICT for teaching and learning purposes. Moreover, instructors indicated that they needed the skill of ICT use specific to teaching and learning. This competence encompasses the skill and knowledge of integrating ICT into teaching and learning based on pedagogical theories and principles. The above descriptions indicate that though ICT competence is one of the prerequisites for using ICT, instructors perceive that they are not proficient in using ICT.

Students' access to ICT infrastructure

Though not in the original framework, student characteristics were found to be important themes emerging from the data. During the FGDs, instructors referred to students encountering difficulties due to a lack of access to laptops, desktops and internet. Due to the continuous increase in students as a result of HE expansion, there is a shortage of ICT resources. Consequently, students are obliged to pay per page for their assignments at commercial computer centers. This situation seems to limit instructors' ICT use in teaching

and learning. There are also situations in which students prefer not to attend ICT-supported classes. This is the case when instructors rush with PowerPoint presentations to cover lessons and students fail to keep up with the instructors' pace (Table 4).

Table 4

Instructors' perception of individual determinants

Theme	Examples of quotations
Instructors' ICT attitude	*B2: "If a person stays away from technology use because of either frustration or skill gap, he/she eventually hates to use it […]. The more you lack the skill to use ICT, the more you stay away from using it and, through time, dislike using it."*
Instructors' ICT competences	*A3: "The technology is fast and we fail to catch it up […] I cannot use such applications as Excel and Access. I rather use common applications like Word and PowerPoint only."*
	C6: "I need to have the skills of delivering my lesson online. […]
	B2: "Simple technical skill of operating ICT is not sufficient for educational use of ICT. A professional skill-pedagogy is also important. For instance, you may prepare a PowerPoint but you need to know how to use it in the classroom."
Students' access to ICT infrastructure	*B2: "Students have limited access to ICT facilities to perform different educational activities including senior essay and projects as a requirement of training programs."*
Students' ICT competences	*C2: "Some students even do not know how to use computer mouse."*

Students' ICT competences

Instructors perceived that their ICT use is determined by the extent to which students are competent ICT users. It was clear from the discussion that, if ICT is to be used in teaching and learning, there should be a favorable environment for both instructors and the students. If instructors have to use ICT in teaching and learning, students also need to have access and competence in using ICT. Participants explained that their students are deficient in ICT use and have limited access to ICT facilities so that ICT integration is challenging.

5.4. Course factors

Two particular aspects of the course factors influence the extent to which ICT is integrated. These are the nature of course and subject matter (Table 5). The participants stated

that there are courses whose implementation demands relatively intensive use of ICT. Natural science and engineering courses are more technology intensive than social sciences. In addition, it was learned during the discussion that, in engineering disciplines, the use of ICT is more extensive. In these disciplines, it is not uncommon to run different software which demands extensive utilization of ICT.

Table 5

Instructors' perception of course factors

Theme	Examples of quotation
Nature of course	B6: *"Most of science subjects call for ICT as a supportive tool for teaching learning process."*
Nature of the subject matter	C4: "*In Engineering, ICT use in teaching-learning is mandatory. It is not an option."*
	C1: *"Some courses demand us to run different software like SPSS, STATA to teach the students in the Lab using computers*."

There is also a difference between theoretical and practical courses in terms of frequency of ICT use. Theory-based courses - those that do not demand extensive experimentation, demonstration and other hands-on experiences - demand a relatively lower level of ICT use compared to practical courses. However, there are practical courses that demand intensive use of ICT because the courses require both students and instructors to run specific educational software. There are also courses that demand recording of different events on site and demonstrating them in the classroom for students. Such courses uniquely demand the intensive application of ICT.

6. Discussion

Results of the current study not only supported determinants in the proposed framework but also extended it by including newly emerged themes, namely, management support, classroom setup, the course-related factors and students' ICT competence and access to infrastructure. In line with previous evidence (Al-Mushasha & Nassuora, 2012; Bakir, 2015; Gillies, 2016) our study showed that instructors seek support, encouragement and guidance from the university management bodies when they decide to integrate technology into their teaching. Above all, it is expected that universities' managements organize training, allocate sufficient budget and supply users with appropriate ICT facilities such as computers and internet. Without adequate administrative support, ICT users face too many challenges.

The instructors indicated that ICT uptake varies across various courses, in particular between specific academic disciplines. Previously, such variations were also reported (e.g., Hbaci, Yu & Ramadan, 2020; Howard, Chan & Caputi, 2015; Mercader, Cristina & Gairin, 2020). A recent study of Mercader, Cristina and Gairin (2020) indicated that obstacles are predominantly perceived in the arts and humanities which might leading to low levels of ICT use.

Our findings also indicated that instructors perceive the importance of considering the students' perspective as determinants of their ICT use. Although our primary focus was on instructors' ICT use, it was highlighted by instructors how important it was to consider the students' situation. Instructors would be challenged to integrate ICT into their teaching in a meaningful manner if there is no favorable environment for students to adopt ICT for their learning. Like instructors, students also require the right level of competence, attitude, support and access to ICT infrastructure (Ali et al., 2018).

7. Limitations of the study

This study has some limitations. First, collecting data at a single point in time from homogenous groups may raise a concern regarding the generalizability of its findings as respondents' perception about determinants of their ICT use may change over time. Secondly, as data originate from instructors in three Ethiopian universities may prevent generalization of its findings to all Ethiopian HE instructors.

Nevertheless, this study adds to the existing body of literature an insight on factors instructors perceive to be relevant in Ethiopian HE to determine their ICT use. This may enable practitioners and managers of the HE institutions, especially those in developing countries to have better insight into what it takes to facilitate ICT uptake, to make informed decisions and to establish strategic goals. Previous studies highlighted access to ICT infrastructure and individual characteristics as major determinants of instructors' ICT use in developing countries (e.g., Ayele & Birhanie, 2018; Bridget, 2016; Raphael & Mtebe, 2016; Kisanga & Ireson 2015). The current study pointed towards the role of student and course-related factors as important determinants of instructors' ICT use. These are worth further research consideration.

8. Conclusions

With this study, we provided evidence about the determinants of ICT usage in the HE context of Ethiopia. On the basis of the literature review, we built a conceptual framework based upon different dimensions and categories: institutional, infrastructure and individual.

Our proposed conceptual framework was, to a large extent, supported by the evidence that was generated from our study. The findings suggested that the determinants of instructors' ICT use are not limited to factors related to the instructors and institutions only. They encompass broader areas including factors related to students and courses. One of the most important lessons from this study is that the study of determinants of educational ICT use in HE provides better insight only when it is investigated from the perspectives of both instructors and students. Another lesson drawn from this study is that the multidimensional nature of ICT determinants indicates that educational ICT use programs and projects in HE in developing countries like Ethiopia need to be tailored, holistic and systematic enough to address the identified determinants.

The present study has implications for future studies. Seemingly, not all ICT use determinants have equal capacity to predict instructors' ICT use (Goeman, 2008). This consideration implies the necessity of identifying determinants that have strong predictive capacity. To this end, it seems appropriate to conduct a follow-up quantitative investigation of the determinants using statistical techniques in order to calculate the effects of each of the identified determinants. In order to obtain findings that have broader application, future studies need to include more sample universities and augment instructors' perception with evidence obtained via observation on a longitudinal base.

Chapter Four: A Structural Equation Model for Determinants of Instructors' Educational ICT Use in Higher Education in Developing Countries: Evidence from Ethiopia

Abstract

In recent years, there has been greater interest and commitment in developing countries to transform their higher education (HE) using ICT. Evidence shows that ICT is underutilized by instructors in these countries. However, a rigorous context-specific model which explains this observation is currently lacking. In this large-scale study, the causal relationships among institutional and individual determinants of HE instructors' ICT use were examined in order to develop a parsimonious model. Survey data were collected from 946 instructors who were randomly selected from six Ethiopian public universities. The results of the structural equation modeling analysis indicated that solely instructors' ICT competence and ICT attitude have a direct impact on their ICT use. The study did not find support for the hypothesized direct impacts of ICT vision and plan, professional development, support, and infrastructure on ICT use. The findings of the current study imply that in developing countries,instructors' ICT use may be improved by intervening in their professional development. Future researches need to focus on designing and assessing professional development interventions that empower instructors with ICT competence and attitude.

Keywords: ICT in education; structural equation modeling; university; developing countries, Ethiopia.

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1. Introduction

In higher education (HE), the adoption of ICT is argued to enable institutions and instructors to provide student-centered education without time or spatial constraints, while promoting the development of 21st-century skills (Barakabitze, Lazaro, Ainea, 2019; Hong & Songan, 2011). Over the last few years, there has been great interest on the part of developing countries in expanding their ICT infrastructure (Kozma & Vota, 2014) and transforming HE by integrating ICT (Barakabitze et al., 2019; Islam & Ake, 2010; Zander, 2016). In Ethiopia, ICT plays a key role in resolving the shortage of qualified and skilled instructors, the high dropout rate (Sakala, 2019), and the limited access to teaching and learning resources (Shelomovska et al., 2016) which are essential to improving HE. Nevertheless, ICT adoption and its diffusion through the HE sector in developing countries has been characterized by a high failure rate (Lubin, 2018) and underutilization (Balarabe & Yushau, 2018; Barakabitze et al., 2019; Sakala, 2019). Ethiopian HE, too, has been suffering from poor ICT use in education (Ergado, 2019; Ergado, Desta & Mehta, 2021).

Unlike ever before, the unique role of ICT in HE institutions (HEIs) has been witnessed internationally since the COVID-19 crisis. COVID-19 has made face-to-face instruction impossible, leaving ICT as a crucial tool to sustain classes without compromising life-saving measures proposed by the WHO to contain the virus. However, while developed countries seemed to have changed successfully to emergency remote (online) teaching, in Ethiopia, for example, this shift was difficult (Tamrat, 2021) and classes did not resume even digitally. Policymakers and academic leaders are challenged to understand better what factors play a crucial role in ensuring ICT use in their specific contexts. Evidence would enable them to make informed decisions so that limited available resources may be wisely used. Unfortunately, such empirical evidence (from developing countries) is scarce.

Concerning ICT, HE in developing countries, particularly in Africa, is characterized by regulatory ineffectiveness, shortage of ICT infrastructure, and shortage of human capital to execute and support ICT use (see Kayisire & Wei (2016) Sabi et al., (2018), amongst others). Therefore, any "proven model" of ICT use in developed countries' contexts may not yield similar output when tried in developing countries (Lim, Ra, Chin & Wang, 2020). Given the context-sensitive nature of technology adoption (Kayisire & Wei, 2016), it is worth investigating the most important contextual variables that determine ICT use in developing countries.

Previous studies regarding instructors' ICT use have unveiled a series of contextual factors. These factors can be situated at institutional and individual levels. Institutional factors

include ICT vision and plan (Barakabitze et al., 2019; Goeman, 2008; Rana & Rana, 2020), professional development intervention (Ayele & Birhanie, 2018; Goeman, 2008; Livingstone, 2015), technical and administrative support (Ayele & Birhanie, 2018; Asuman & Clement, 2018) and ICT infrastructure (Asuman & Clement, 2018; Barakabitze et al., 2019). Research evidence also showed that instructors' attitude towards ICT (Barakabitze et al., 2019; Isiyaku, Ayub, & Abdulkadir, 2015; Rohayani, Kurniabudi, & Sharipuddin, 2015) and ICT competence (Bervell & Umar, 2017; Rohayani et al., 2015) are prominent determinants of ICT use. While these studies focused on identifying determinants of ICT use (e.g., see Ali, Uppal, & Gulliver, 2018; Ergado et al., 2021), they often failed to assess the weighted impact of the different predictors and to indicate the model's predictive validity.

Given these considerations, and the underrepresentation of research evidence from developing countries in the scientific literature (Al-khasawneh & Obeidallah, 2015; Rana & Rana, 2020), there is a need to examine an integrated causal relationship between the most important determinants of instructors' ICT use. Therefore, this study intends to propose and empirically test a parsimonious (i.e. with strong explanatory power and the least possible variables) instructors' ICT use model responsive to the context of developing countries. Drawn from the research literature, a set of hypotheses is developed regarding the effects of factors at the individual and institutional level on instructors' ICT use. Subsequently, ICT use data is collected from a large sample of Ethiopian HE instructors, to assess the research model using structural equation modeling.

2. Research context

Ethiopia is the second-largest and most populous African country located on the horn of Africa. HE is only seven decades old in Ethiopia. HE began only in 1950 with the establishment of the University College of Addis Ababa (UCAA) which later, in 1961, was renamed Hailesillasie I university. During its establishment, the UCAA consisted of faculties of Arts and Science (Agriculture Science, Engineering and Public Health) (Semela, 2011) and eventually expanded to include faculties of Education, Law, Medicine, Social Work and Business Administration in 1961 (Geda, 2014). The expansion of universities and enrollment rates were not significantly improved twenty-five years after the establishment of the first university. The number of public universities increased to three including the University of Asmara (Eritrea was a part of Ethiopia by then) and Alemaya University which were established in 1979 and 1985 respectively (Wagaw, 1990). The gross enrollment in HE, which was 0.2% in 1970, was increased to only 0.7% in 1975 (World Bank, 2003). Recently, HE has

been under massive expansion in both the public and private sectors. The number of public universities which was 2 till 2000 has currently increased to 50 in 2018/19 (MoSHE, 2020a) and the gross enrollment rate reached 10.2% in 2017 (MOE, 2017).

The Ethiopian HE sector has its own characteristic features. In this regard, Woldegiyorgis (2015) has analyzed the context of Ethiopian HE from the developmental state perspective and reported that the HE is characterized by (a) a high level of state control (e.g., appointment of top managing bodies of universities including board members, university presidents and vice presidents by the government, (b) centralized students' admission (university entrance exam, criteria for entrance and intake capacities of universities are decided centrally), (c) isomorphism (since the HEIs serve comparable missions of teaching and learning, research and community service, have the same funding scheme, and similar governance structure, they tend to show isomorphism instead of diversity (MoSHE, 2020a). However, since 2020, there is a centrally initiated movement towards differentiating universities into research, applied, and comprehensive universities with different focus areas (see MoSHE, 2020) and (d) based on the development direction set by the government and centrally designed strategy, all universities are forced by the government to focus on training Engineers. This is mainly expressed via the 70:30 intake capacity scheme in which 70% of new entrants need to be admitted in the different training areas of engineering while only the remaining 30% join the rest of the training programs. As a result of the massification of HE in Ethiopia, its quality seems to be compromised. In the Ethiopian HE sector, issues of access, relevance, equity, and quality remain the major challenges that need to be addressed during the implementation period (2018-2030) of the current education development roadmap (MoE, 2017).

ICT is a relatively new phenomenon in Ethiopia (Alemu, 2017) and its implementation in the education sector is at an infant stage (Ergado et al., 2021). The Ethiopian government has embarked on ICT-enabled transformation in all sectors including education to enhance performance and deliver better public service with the ultimate goal of improving the lives of its citizens (Lixi & Dahan, 2014). In its fifth Education Sector Development Program (ESDP V), the government plans the expansion of ICT integration to transform the quality of teaching at all levels of education (MoE, 2016). The plan describes several initiatives including the development of an ICT plan, expansion of ICT infrastructure, and the use of a learning management system (LMS) (MoE, 2016). However, these initiatives seem to be not fully implemented, and consequently, ICT integration in HE is yet to be realized in the country.

3. Theoretical framework of the study

Successful ICT use needs understanding of the complex relationships between institutional and individual level determinants. Such relationships between determinants of instructors' ICT use can be better understood by theories and models that encapsulate multidimensional determinants than those focusing at either institutional or individual level. The main theoretical basis for this study stems from the integration of resources, infrastructure, people, polices, learning, evaluation and support (RIPPLES) model of Surry, Ensminger and Haab (2005) and the Will, Skill and Tool (WST) model of Christensen and Knezek (2001). The RIPPLES model is selected to be adopted as a theoretical lens for the study as it (a) provides a broad theoretical ICT adoption model that enables one to capture institutional and individual level determinants that influence technology adoption in the context of HE (Benson & Palaskas, 2006), (b) is based on previous theories such as Roger's Diffusion of Innovation Theory (Rogers, 1995), Hall and Hord's Seminal work on change in school (1987), Ely's eight conditions for ICT adoption (Ely, 1999), the critical factors in the adoption checklist developed by Stockdill and Morehouse (1992), Burkman's (1987) user-oriented instructional development model, and the concept of adoption analysis based on "Dean's survey" (Surry, Ensminger & Haab, 2005), and (c) is supported by empirical evidence generated from HE in developed (e.g., Benson & Palaskas, 2006; Jasinski; 2007; Vandover; 2013) and developing countries (e.g., Nyirongo, 2009). According to the RIPPLES model, the following seven conditions determine technology integration in HE.

- ✓ Resources refer to financial resources required to purchase basic ICT infrastructure and learning materials.
- ✓ Infrastructure is ICT hardware, software, facilities, and network that must be in place to facilitate ICT use.
- ✓ People refer to the needs, hopes, values, skills, and experiences of the people who adopt the innovation.
- ✓ Policies describe the need for organizational policies and procedures which are fundamental in governing and guiding technology adoption.
- ✓ Learning relates to the notion that if technology is to be successfully adopted, the university management and teachers need to view technology as a tool that can enhance the teaching-learning process.
- ✓ Evaluation refers to the idea that the integration of technology in to teaching and learning should be constantly reviewed. Evaluation of the adopted technology should

be carried out in light of its role in realizing learning goals and costs and benefits of implementing technology and,

- ✓ Support deals with arrangement of user support system so as to assist technology adopters. The support component includes training, technical support, pedagogical support, and administrative leadership (Surry, Ensminger and Haab 2005).

In addition, WST model of technology integration (Christensen & Knezek, 2001) postulates that will (attitude), skill (competence) and tool (access to ICT infrastructure) determine instructors' ICT use. Will denotes the affective inclination toward the use of technology in teaching. Skill refers to the ability to accomplish ICT-related educational activities and tool pertains to the availability and accessibility of ICT infrastructures (Sasota et al., 2021). Several studies adopted the WST model (Knezek & Christensen, 2015) and reported that the model explains from 60-96% variation in teachers ICT integration (Farjon et al., 2019). It is, therefore, assumed that the combination of the RIPLLES and the WST models gives a more comprehensive framework to capture individual and institutional characteristics that determine instructors' educational ICT use in HE in developing countries. In order to validate the relevance of determinants in the RIPPLES and WST models to the study context, a qualitative study was conducted prior to the current study. The qualitative study indicated that institutional (ICT vision and plan, ICT infrastructure, ICT support, and professional development) and individual (instructors' ICT competence and attitude) characteristics determine their ICT use. For complete report of the study see Ferede, Elen, Van Petegem, Hunde and Goeman (2021). The determinants in the hypothesized model are, therefore, relevant to the study context as they are validated based on prior empirical study.

4. The research hypotheses

As indicated above, the qualitative study indicated several institutional and individual determinants of instructors' ICT use. The possible relationship among the determinants and ICT use are hypothesized based on evidence in the literature. The relationships between the determinants are encapsulated in Figure 1: Hypothesized model with determinants of ICT use and their interrelationships. The following sections, based on a review of additional prior empirical studies and theoretical claims, present the theoretical background to the hypothesized relationships between the determinants, the research methods, the result, discussion and conclusion, and direction for future studies.

4.1. Impact of institutional factors on instructors' ICT use

In their study, Vanderlinde, Aesaert and van Braak (2014) asserted that professional development, vision, and policy are positively associated with ICT use. Similarly, Tondeur, Van Keer, Van Braak, and Valcke (2008) found that teachers working in schools with shared ICT goals use ICT more frequently. Moreover, ICT integration in the classroom is stimulated by an ICT plan at school (Tondeur et al., 2008). Other studies showed that ICT integration is contingent upon the development of a shared ICT vision (e.g., Otto, 2001; Hughes & Zachariah, 2001). Studies in the context of HE showed similar results. Goeman (2008) and Zhu (2015), for example, found that a shared ICT use vision is a significant predictor of e-learning implementation. Baylor and Ritchie (2002) found that professional development (PD) was a significant predictor of technology use for educational purposes. Based on these findings, the following hypotheses were formulated:

Hypothesis 1*: The availability of professional development has a direct positive effect on instructor's ICT use.*

Hypothesis 2*: The availability of an ICT vision and plan has a direct positive effect on instructor's ICT use.*

Tondeur, van Keer, van Braak and Valcke (2008) found that ICT support is a strong predictor of teachers' use of ICT in their classrooms. Other studies confirmed that availability and accessibility of resources and technical support influence ICT use (Peralta & Costa, 2007; Norris, Sullivan, Poirot & Soloway (2003). In addition, institutional support plays a significant role in the professional development of instructors in using ICT (Garet, Porter, Desimone, Birman & Yoon, 2020; UNESCO, 2004; Vanderlinde, van Braak, & Dexter, 2012). ICT integration, as well as instructors' professional development, is contingent upon collaborative and visionary leaders (Lee & Nie, 2017; Scrimshaw, 2004), who can plan and steer targeted, evidence-based interventions, and propagate a vision in a participatory manner (Somekh, 2008). Universities guided by a carefully developed ICT vision and plan prioritize relevant activities and efficiently utilize the limited resources for the expansion of their ICT infrastructure (Hew & Brush, 2007; Fishman & Pinkard, 2001). It will also positively affect the process of acquiring fundamental ICT infrastructure (Kozma & Voogt, 2003). Given these considerations, the following hypotheses were put forward:

Hypothesis 3*: The availability of an ICT vision and plan has a direct positive effect on the availability and accessibility of ICT infrastructure*

Hypothesis 4*: The availability of an ICT vision and plan has a direct positive effect on ICT support*

Hypothesis 5*: ICT support has a direct positive effect on the availability and accessibility of ICT infrastructure*

Hypothesis 6*: ICT support provided has a direct positive effect on ICT use*

Hypothesis 7*: The availability and accessibility of ICT infrastructure has a direct positive effect on ICT use*

Hypothesis 8*: ICT support has a direct positive effect on instructor's professional development*

Hypothesis 9*: The availability of an ICT vision and plan has a direct positive effect on instructor's professional development*

Vanderlinde and van Braak (2010) showed that professional development influences teachers' ICT competences, and vice versa. Moreover, a study by Teo and Wei (2001) revealed that PD influences instructor's attitude towards ICT use. Consequently, the following hypotheses were posited:

Hypothesis 10*: The availability of professional development has a direct positive effect on instructor's ICT attitude.*

Hypothesis 11*: The availability of professional development has a direct positive effect on instructor's ICT competence*

4.2. Impact of individual factors on instructors' ICT use

Hakkarainen et al.'s (2001) study showed that teachers' ICT use is directly influenced by their ICT competence. Likewise, in Ghanaian schools, Buabeng-Andoh (2012) found a positive association between teachers' ICT competence and ICT use for teaching and learning purposes. Similar studies confirmed this finding (e.g., Afshari, Bakar, Luan, Samah, & Fooi, 2009; Almerich, Orellana, Suárez-Rodríguez, & Díaz-García, 2016; Peralta & Costa, 2007; Tezci, 2009). In Zhao and Frank (2003), Peralta and Costa (2007), Tondeur et al., (2008), and Tezci (2009) a favorable ICT attitude was associated with higher levels of ICT usage in schools. As reported by several authors, a bidirectional relationship exists between ICT attitude and competence. In other words, teachers' attitude towards ICT affects their ICT competence and vice versa. This was confirmed by others (e.g. Hughes & Zachariah, 2001;

Teo & Wei, 2001; Zhao & Frank, 2003). Based on these findings, the following hypotheses were formulated:

Hypothesis 12*: Instructor's ICT competence has a direct positive effect on instructor's ICT use*

Hypothesis 13*: Instructor's ICT attitude has a direct positive effect on instructor's ICT use*

Hypothesis 14*: Instructor's ICT attitude has a direct positive effect on instructor's ICT competence.*

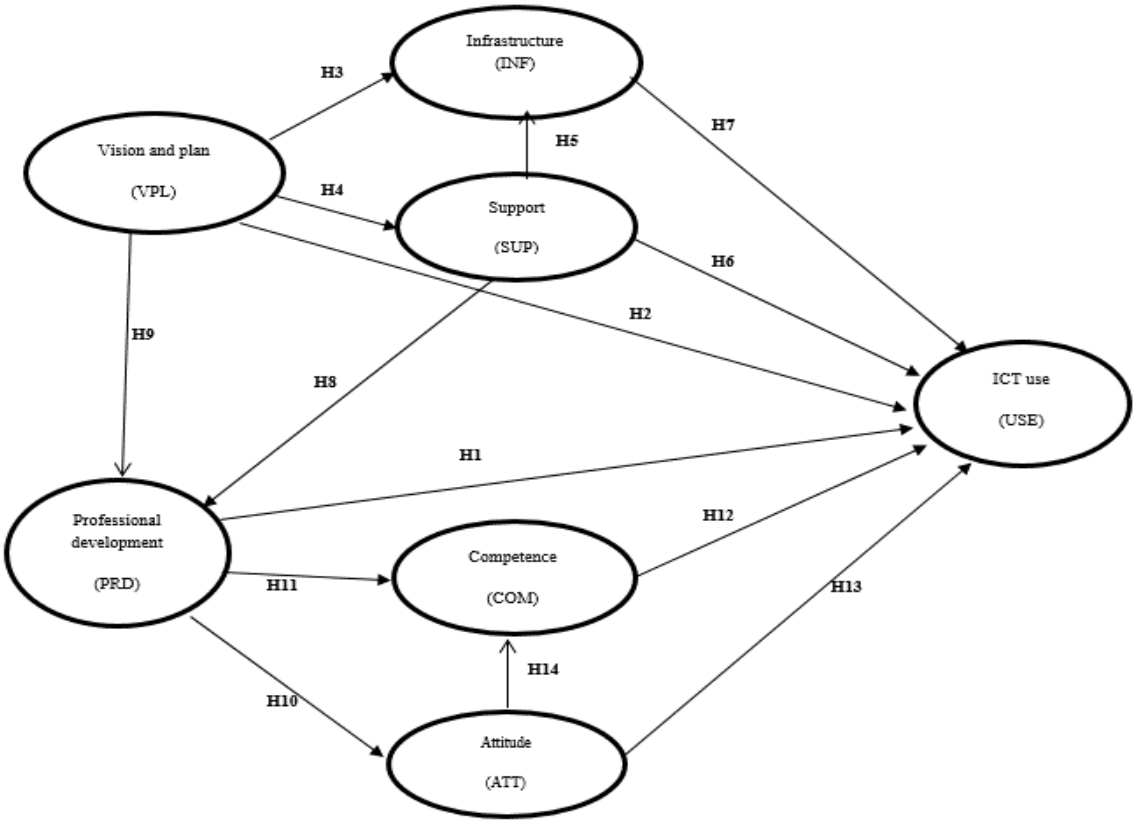

Figure 1: *Hypothesized model with determinants of ICT use and their interrelationships*

5. Research method

Since the purpose of the current study is to test the aforementioned set of hypotheses (the hypothesized model) it adopted a quantitative research approach.

5.1. Participants

Data were collected from 946 instructors randomly selected from six public universities in Ethiopia. Seventy-nine percent or 747 of the instructors had a master's degree, while 6.1% (n = 58) held a Ph.D. The proportions of female and male instructors were 15.1%

(n = 143) and 82.9% (n = 784) respectively. The low proportion of sample female instructors was due to high gender disparity in Ethiopian university instructors that favors males. According to recent data obtained from MoSHE (2020), at national level, the proportion of female instructors is 18.5% which is slightly above the proportion of sample female instructors represented in the current sample. A high proportion of the sample, 26.2% (n =248) was represented by instructors in the Engineering and Informatics faculty followed by health science, 24% (n = 227). The lowest proportion of the sample was represented by the faculty of Education, which consisted of a relatively small number of training programs across the universities, with some universities not offering this area.

5.2. **Instrument**

A face-to-face survey was developed to measure ICT vision and plan, professional development, ICT infrastructure, support, ICT attitude, ICT competence, and ICT use behavior of instructors. The results are presented in Table

Table 1
Constructs and their respective conceptualizations

Construct	Conceptualization	References
VPL	Refers to (a) the extent to which universities have a clear and shared vision regarding the place of ICT in teaching and learning and (b) a plan containing overall philosophy and goals of ICT use in education, technical and infrastructural specification, strategies of implementation, and monitoring and evaluation techniques.	Zhu, (2015), Vanderlinde et al., (2012), Vanderlinde, Aesaert and Van Braak, (2014) Vanderlinde et al., (2012)
PRD	Refers to training/courses, online tutorials, workshops, and seminars that aim at improving instructors' competence in how ICT can be used in teaching and learning.	Yurdakul, Odabasi, Kilicer, Coklar, Birinci and Kurt (2012), Al-Busaidi and Al-Shihi, (2012), Teo and Wei (2001), Vanderlinde et al., (2012)
INF	Refers to computers, the internet, and their application which are used for teaching and learning purposes.	
SUP	Refers to technical and administrative support provided to instructors to promote ICT use in teaching and learning activities.	Vanderlinde and van Braak (2010), Moses, Bakar, Mahmud, and Wong, (2012), Dexter, Anderson and Ronnkvist (2002)
ATT	Refers to instructors' predisposition to use ICT in their teaching and learning activities.	Krosnick, Judd, and Wittenbrink, (2005), Hernández-Ramos, Martínez-Abad, García Peñalvo, Esperanza Herrera García, and Rodríguez-Conde, (2014)
COM	Refers to the instructors' perception of the extent to which they find themselves competent in using ICT in the teaching-learning process.	Vanderlinde, Aesaert and Van Braak, (2014), Vanderlinde et al., (2012).
USE	Refers to instructors' self-reporting of the extent to which they adopt computers, the internet, and their applications in teaching and learning activities.	Meneses, Fàbregues, Rodríguez-Gómez, and Ion (2012), van Braak, Tondeur, Valcke, and Van Braak, (2004)

Items for measuring the variables were adapted from previous literature. To ensure the content validity of the instrument and adapt it to the study setting, two procedures were carried out, namely, review and rating of the survey items by experts. The survey items which consisted of 79 items were reviewed and rated by five academic staff members with different expertise (Computer science, Psychology, Curriculum and instruction, and Language and literature), levels of education (2 Ph.D. and 3 Masters Degree holders) and range of service years (from 4 to 19 years).

In the first place, the feedback obtained from the experts was organized according to three themes namely items to be removed, added and reworded. Four items were suggested by experts to be not relevant to the context of Ethiopian HE (*I can design web page* (competence), *The architecture of classrooms is suitable enough to use ICT* (Infrastructure), *My university administrator support ICT use by reducing workload of instructors* (support), *participate in the management of my department* (use). It was suggested that three items be added as they were relevant to the study setting (*In my university, the ICT contact person is willing to support me in using ICT* (support), *In my university, the ICT contact person is capable to support me in solving technical ICT problem* (support), *There is uninterrupted electricity supply* (infrastructure)). Several items were proposed for rewording. The four items that were suggested by experts to be less relevant to the study context were not immediately removed. Instead, all survey items were further rated by the five experts to evaluate the agreement between the experts using a four-point scale (1=Not relevant, 2=somewhat relevant, 3=quite relevant and 4=highly relevant) (Polit et al., 2007). Accordingly, based on the experts' rating, five items with less than 0.78 content validity index (CVI) were identified and removed from the survey. An item with a CVI of .78 or higher for three or more experts could be considered evidence of good content validity (Polit et al., 2007). Among the five items with less than 0.8 CVI, three of them were the ones which were suggested by the experts to be less relevant to the Ethiopian HE context during the review. The two items that were removed based on the CVI were items under the construct vision and plan (*The students, instructors, administrative bodies and other stakeholders participated in the process of developing my university's ICT strategy)* and attitude *(Using ICT result in a higher education with a greater degree of interdisciplinary).* The final survey consisted of 77 items. Table presents measurements of the constructs and their respective sources.

Table 2

Measurement items and their sources

Construct	Example of the measurement items	Sources
VPL (7 items)	*My university's vision of the place of ICT in education is well-known by all instructors.*	Vanderlinde and van Braak (2010)
PRD (6 items)	*My university organizes training workshops on ICT use in education.*	Vanderlinde and van Braak (2010); Al-Busaidi and Al-Shihi (2012)
SUP (16 items)	*In my university, I receive enough technical support while working with ICT.*	Vanderlinde and van Braak (2010); Isleem (2003)
INF (9 items)	*There are enough computers and computer peripherals in my university to use for educational purposes.*	Elshaikhi (2015)
ATT (14 items)	*I accomplish more tasks in my classes due to the use of ICT.*	Hernández-Ramos et al., (2014)
COM (15 items)	*I can share instructional materials that I find online (via e-mail, Dropbox, Google Drive, etc.) with my students and colleagues.*	Türel et al., (2017)
USE (10 items)	*I use ICT to maintain a repository of educational resources for my teaching.*	Meneses et al., (2012); (Braak et al., 2004)

5.3. Data Collection and Analysis

A face-to-face survey was administered to the sampled instructors from the universities in the study. The instructors were asked to rate the extent of their agreement with the survey items using a five-point Likert scale from 1 (Never) to 5. (Very Often) for ICT use and 1 (strongly disagree) to 5 (strongly disagree) for the rest of the constructs. The instructors' responses were grouped into seven variables based on exploratory factor analysis (EFA), specifically the principal component analysis result: VPL, PRD, INF, SUP (technical as well as administrative support), ATT (cognitive ICT attitude and ICT value attitude), COM (basic hardware operation competence, personal ICT use competence and ICT use in teaching competence) and USE. The data were analyzed using structural equation modeling (SEM) in two steps, the measurement model and the structural model. The hypothesized measurement model was tested using confirmatory factor analysis (CFA) with SPSS AMOS 17.0. The goodness of fit was tested using five parameters, absolute fit χ^2, *df, comparative fit index*

(CFI), goodness-of-fit index (GFI), Tucker-Lewis index (TLI), standardized root mean square residual (SRMR) and *root mean square error of approximation (RMSEA)*. Since the chi-square value is sensitive to a large sample size (e.g. N=800 or above) (Jackson & Jackson, 2009), the test relied on alternative fit indices for all model fit evaluations (Thomas et al., 2013).

6. Results

6.1. Descriptive Statistics

As depicted in Table 6, the mean scores of the variables ranged between 2.61 (*SD* = 0.88) and 3.93 (*SD* = 0.87). ICT attitude and ICT infrastructure scored the highest and lowest mean scores, respectively. The participants appraised ICT support provided to them as well as their perceived ICT competence and attitude positively ($\bar{x} > 3$). However, the participants evaluated the availability of an ICT vision and plan, professional development interventions, availability and accessibility of ICT infrastructure, and their ICT use negatively ($\bar{x} < 3$). The skewness and kurtosis values for all the variables were within the acceptable range (skewness value between +1 and -1 and kurtosis value of less than 2) (Kline, 2005) which indicates normality of distribution. Missing value analysis was conducted before data analysis. Accordingly, the missing values for all the study variables were less than 5% so that the data is eligible for analysis. Furthermore, Little's missing value analysis (MVA) was conducted to test whether or not the missing values are random (MRA). Though it is not necessary to conduct MVA for a missing value of less than 5%, the pattern is more important than the size of the missing value (Tabachnick & Linda, 2013). Accordingly, a P-value (p =.226) which is greater than 0.05 indicated that the probability that the pattern of missing diverges from randomness is greater than .05, so that missing completely at random may be inferred.

Table 6

Descriptive statistics

	Mean	Standard deviation	Skewness	Kurtosis
VPL	2.99	.87	-.170	-.398
PRD	2.74	.83	-.030	-.470
SUP	3.56	.79	-.698	.372
INF	2.61	.87	.232	-.521
ATT	3.93	.66	-.980	1.746
COM	3.69	.73	-.699	.752
USE	2.75	.76	.078	-.146

6.2. Structural equation modeling

The structural modeling analysis was conducted at both the measurement and structural levels. The analyses were conducted using the maximum likelihood estimation (MLE) procedure. The MLE procedure was adopted because it is a robust procedure for use in SEM (Schumacker & Lomax, 2010) and is appropriate for a large sample size like the current study (946) (Joreskog & Sorbom, 1982).

Measurement model

Model fitness, construct reliability and construct validity were used as criteria to test the measurement model.

Model fitness: Model fitness was determined based on *GFI, CFI, TLI, RMSEA* and *SRMR*. Values of 0.90 or more for the *CFI, GFI,* and *TLI*, and values of 0.08 or less for *RMSEA* and *SRMR* indicate a good fit (Hair, Black, Babin, & Anderson, 2010). As indicated in Table 7, all model fit statistics except the GFI value were within the acceptable ranges ($\bar{x}$= 6208.353, *df* = 2372, $\bar{x}/df$ = 2.62), *CFI* = .908, *TLI* = .904, *RMSEA* = .041 and *SRMR* = .0568. The *GFI* value of .885 was also close to the target statistics of .90 which indicated that the data fit the hypothesized measurement model.

Table 7

Confirmatory factor analysis results

	χ^2	*Df*	χ^2/df	*GFI*	*CFI*	*TLI*	*RMSEA*	*SRMR*
Model	6208.353	2372	2.62	.885	.908	.904	.042	.0568
Acceptable range			<3	≥.90	≥.90	≥.90	<.08	<.08

Construct reliability and validity. Construct reliability and validity were determined using three criteria namely, composite reliability (*CR*), Cronbach's alpha (α), and average variance extracted (*AVE*) (Hair, Black, Babin, & Anderson, 2010). Anderson and Gerbing (1988) suggested a *CR* value of 0.7 to determine to construct reliability. As shown in Table 5, *CR* values for all the seven constructs had values higher than 0.90. The Cronbach's alpha coefficients of all the constructs were above 0.7 which indicates the constructs' reliability (Fornell & Larcker, 1981). Convergent validity is acceptable when the *AVE* is greater than 0.5 (Hair, Black, Babin, & Anderson, 2010). As shown in Table 8 the *AVE* values for all the seven constructs were within the acceptable range which indicated that the constructs exhibit convergent validity.

Table 8

Construct reliability and validity

		CR	*AVE*	*Cronbach's alpha*
1	VPL	0.966	0.807	0.91
2	PRD	0.919	0.745	0.86
3	SUP	0.982	0.819	0.93
4	INF	0.961	0.758	0.89
5	ATT	0.984	0.822	0.92
6	COM	0.986	0.827	0.92
7	USE	0.950	0.630	0.91

Discriminant validity: Discriminant validity was judged by comparing the square root of *AVE* with a correlation between the construct and other constructs in the model. As a rule of thumb, the construct has a discriminant validity when the square root of *AVE* is greater than the correlation between the constructs (Chin, 1998). As depicted in Table 9, the square roots of *AVE* (leading diagonal) values were greater than the corresponding inter-construct correlation (the off-diagonal elements). We, thus, concluded that the constructs exhibit discriminant validity.

Table 9

Discriminant validity of the measurement model

	VPL	PRD	SUP	INF	ATT	COM	USE
VPL	(.898)						
PRD	.609**	(.863)					
SUP	.649**	.610**	. (904)				
INF	.608**	.500**	.703**	(.870)			
ATT	.293**	.264**	.302**	.196**	(.906)		
COM	.247**	.303**	.282**	.239**	.509**	(.909)	
USE	.215**	.275**	.267**	.221**	.377**	.524**	(.814)

Note. ** p<0.01

Diagonal in parentheses: square root of average variance extracted from observed variables (items); and off-diagonal: correlations between constructs.

Structural model

The hypothesized structural model was tested using SEM. As depicted in Table 10, except for the GFI value of .872, which is closer to the target 0.9, all the other fit indices coefficients were within the acceptable range: $\bar{x}/df$ = 2.644, *GFI* = .872, *CFI* = .906,*TLI* = .902, *RMSEA* = .042, *SRMR* = 0.0673. These results indicate that the proposed research model has a good fit.

Table 10

Fit measures for the structural model

	χ^2	*Df*	χ^2/df	*GFI*	*CFI*	*TLI*	*RMSEA*	*SRMR*
Model	6291.869	2380	2.644	.872	.906	.902	.042	0.0673
Acceptable range			<3	≥.90	≥.90	≥.90	<.08	<.08

Direct Effects

Table 11 shows the direct effects between the determinants. PRD, VPL, SUP, and INF did not have a significant impact on USE, which contradicts respectively hypotheses 1, 2, 6, and 7. Compliant with hypotheses 3, 4, and 9 VPL was found to have a direct significant influence on respectively INF (β = .224, t = 5.248, p<0.01), on SUP (β = .772, t = 18.861, p<0.01) and on PRD (β = .291, t = 6.265, p<0.01). The fifth hypothesis, a direct effect of SUP on INF was reported (β = .653, t = 13.172, p<0.01). PRD was found to have a significant direct influence on ATT (β = .266, t = 5.784, p = 0.00), and ATT in its turn affects COM (β = .702, t = 10.818, p<0.01), which supported respectively hypothesis 10 and 14. Finally, the direct influence of COM on USE (β = .427, t = 6.956, p<0.01) and ATT on USE (β = .167, t = 2.462, p<0.05) were also found to be significant (support for hypothesis 11 and 13). COM proved to be a stronger predictor of USE as compared to ATT. Both COM and ATT together explain 35% variation in the dependent variable (USE).

Table 11

Direct effects between determinants of instructors' ICT use

Hypothesis	Relationship	β	*S. E*	*T*	Results
1	PRD → USE	.026	.053	.452	Not supported
2	VPL → USE	.030	.052	.566	Not supported
3	VPL → INF	.224**	.046	5.28	Supported
4	VPL → SUP	.722**	.034	18.6	Supported
5	SUP → INF	.653**	.061	13.172	Supported
6	SUP → USE	.082	.091	.979	Not supported
7	INF → USE	.043	.060	.648	Not supported
8	SUP → PRD	.530**	.060	10.571	Supported
9	VPL → PRD	.291**	.049	6.265	Supported
10	PRD → ATT	.266**	.029	5.784	Supported
11	PRD → COM	.029	.029	.797	Not supported
12	COM → USE	.427**	.072	6.96	Supported
13	ATT → USE	.167*	.100	2.42	Supported
14	ATT → COM	.702**	.082	10.818	Supported

Note. ** p<0.01, * p<0.05

Indirect and total effects

In Table 12, the standardized regression coefficients that resulted from the mediation analysis are presented. The results indicated that PRD had a significant indirect influence on COM via ATT. In addition, VPL was found to have a significant indirect influence on INF through SUP. Furthermore, ATT was found to have a significant indirect influence on USE via COM. Finally, VPL was found to have an indirect effect on SUP and ATT via PRD (Table 12).

Table 12

Standardized regression coefficients for mediation analysis

	Direct effect	Indirect effect	Total effect
PRD→ ATT→COM	.025	.230*	.255
VPL→ SUP→INF	.21*	.503*	.713
ATT→ COM→USE	.171	.298*	.469
VPL → PRD→SUP	.72*	.154*	.874
VPL → PRD→ATT	-	.143*	.143

Note. * p<0.05

7. Discussion

The purpose of this study is to examine the integrative causal relationships among several factors: ICT vision and plan, professional development, support, ICT infrastructure, instructor's ICT attitude, ICT competence, and ICT use using structural equation modeling. The variables were measured using a self-reported questionnaire.

Both the measurement and structural models indicate that the hypothesized model fits the data obtained. Based on the SEM analysis support was found for nine hypotheses out of the fourteen. Among them, only the individual factors (ICT competence and attitude) were found to be significant predictors of instructors' ICT use with the model's overall explanatory power of 35%. First of all, in line with Bordbar (2010), Buabeng-Andoh (2012), Goeman (2008), Lawrence, and Tar (2018) it is found that ICT competence influenced ICT use positively. In other words, when instructors perceived themselves to be sufficiently competent in using ICT, they reported higher ICT usage. Probably, the frustration that arises from not being able to use ICT prevents instructors from using technology extensively in their teaching practice. The direct effect of ICT attitude on ICT use implies that those instructors with a favorable attitude reported higher educational use of ICT. Also, this finding does not deviate

from previous evidence (e.g. Drent & Meelissen, 2008; Goeman, 2008; Hew & Brush, 2007; Kersaint, Horton, Stohl & Garofalo, 2013; Mueller, Wood, Willoughby, Ross, & Specht, 2008, Tezci, 2009; Drossel, Eickelmann, & Gerick, 2016; Lawrence & Tar, 2018). Instructors' ICT attitude plays a pivotal role. Not only does it impact their use, but also their competence. Plausibly, this is because instructors with a more positive attitude towards ICT are more eager to learn new skills and/or are more persistent in applying new knowledge and continue despite difficulties. The finding that ICT attitude influences ICT competence is congruent with claims made by other authors such as Teo and Wei (2001), and Zhao and Frank (2003). One noteworthy finding is the strength of competence as a predictor of ICT use, as compared to attitude. This result contrasts with, for example, Goeman (2008). However, there are also references in literature that reported positive attitudes and deficiencies in competences (e.g. Tibebu, Bandyopadhyay, & Negash, 2009). As such, instructors may be empowered more easily to use ICT (Khan, Hossain, Hasan & Clement, 2012).

Somewhat surprisingly, none of the four institutional factors of the model affected directly ICT use. However, the ICT vision and plan were noted to have a positive influence on infrastructure, support, and professional development. UNESCO (2004), as well as Vanderlinde, van Braak and Dexter (2012), reported that educators are more likely to perceive their context as an enabling environment for ICT usage when their institution has implemented measures at the managerial level. Furthermore, while professional development seems to influence ICT attitude directly, its impact on ICT competence is mediated by ICT attitude. In other words, the more instructors ascertain to engage in organized training, workshops, and seminars, the more favorable they tend to be towards ICT use. This finding is consistent with findings of previous studies (e.g., Teo and Wei, 2001). The impact of professional development on ICT competence is contingent upon ICT attitude which means that interventions in professional development will improve instructors' competences only if they are perceived to help develop a favorable ICT attitude. Professional development had, thus, an indirect influence on self-reported ICT use, contradictory to what was expected. However, the path analysis shows the mediating role of ICT attitude. The impact of ICT-related interventions in the domain of professional development is initially noticed in terms of attitude changes. Thereafter, it seems instructors value more their educational ICT use.

8. Theoretical implications

The study's finding indicate that instructors' ICT competence and attitude are significant predictors of their ICT use. In both the RIPPLES and the WST models, several

factors are hypothesized to determine ICT use. However, only the people (values and skills of instructors) of the RIPPLES model or the attitude and competence aspects of the WST model were supported by this study as significant and direct predictors of instructors' ICT use. This means that when analyzed in an integrated manner, ICT use determinants that are related to individuals (instructors) are more important than those related to institutions in the context of developing countries. This finding reminds us of a claim made by Lynch (2002) decades ago stating that, "in making the best use of digital technology in higher education, budgets and bandwidth aren't the main obstacles, professors are. Faculty members need to embrace new technologies in the classroom" (p. 1). This finding is backed up by recent research evidence that has been emerging regarding ICT use in HE during COVID 19. Studies, particularly those conducted in developing countries, have been showing that instructors' ICT competence remains a significant predictor of their ICT use (e.g., Bariu, Chun, & Boudouaia, 2022). Also, a number of recent studies reported that in developing countries, instructors' ICT competence and attitude are critical barriers to their ICT use during the COVID 19 pandemic (e.g., Cahyadi, 2020; Chang & Fang, 2020; Mishra, 2021). The finding of the current study further indicate that instructors' ICT competence is more important than their ICT attitude when it comes to ICT use. This finding is hardly examined in ICT use literature in HE in developing countries. The findings of this study add an insightful perspective regarding factors that are decisive for instructors' ICT use in the context of developing countries, one which is rarely discussed in the literature. Such understanding enables planners and leaders of HEIs to appreciate, from the perspective of instructors, what is decisive in order to integrate ICT in education and make an informed decision.

9. Practical implications

As stated in the discussion section, the findings of the current study show that instructors' ICT competence and attitude are powerful determinants of their ICT use. This may imply that, in developing countries, instructors ICT use is improved by intervening in their ICT competence and attitude. If HE institutions expand their ICT infrastructure with little attention to the empowerment of instructors by developing competence and a favorable attitude, such effort is likely to miss its main goal (Unwin, 2007). In contrast to a better institutional reputation and an artificial showcase, investments in high-tech equipment and connectivity do not determine instructors' use of ICT for teaching and learning purposes. ICT is to be regarded as a means to improve teaching and learning, not as an end in itself, as was repeatedly noted after failures of ICT implementation in developed countries. Given the aspirations of HE in developing countries, their willingness to achieve satisfactory levels of

ICT integration, planned actions to combat lack of know-how and skepticism regarding the use of ICT for teaching and learning purposes seem to be of crucial importance. Moreover, with the recent outbreak of COVID-19, one may argue in favor of a sense of urgency. HEIs and their instructors have been pushed to accept the key role of ICT to reach out to students, facilitate teaching and learning from remote sites, and resume interrupted classes while maintaining life-saving health measures. Without an improvement of instructors' ICT competence and a 'molding' of their attitude, ICT use will remain a mere ambition. In this regard, instructors' ICT professional development is a key to improve their competence and attitude Such instructors' ICT professional development needs to (a) be evidence-driven (contextualized) (Getenet, 2020), (b) be supported by the university's management (Oliso, 2017), (c) be informed by relevant pedagogic theories. In this regard, adult learning theory is the most appropriate for it promotes the immediate application of the knowledge and skills instructors gained from professional development (Zepeda et al., 2013), (d) keep instructors updated in three aspects of learning; content, pedagogy and technology (Schildkamp et al., 2020), (e) actively engage the instructors (Darling-hammond et al., 2017; Schildkamp et al., 2020) (f) provide instructors with hands-on experiences for technology use (Carlson, 2002) (g) promote collaboration among instructors (Darling-hammond et al., 2017) and (h) be designed for a reasonable duration, not one shot short training (Inamorato dos Santos et al., 2019). Thus, HE ICT policy in developing countries may prioritize effective and contextualized instructors' professional development and create enabling institutional characteristics which empower them.

10. Limitations of the study

This study has some limitations. All variables except for ICT attitude were measured using a self-report questionnaire, in other words using proxy measures. Though there is no conclusive finding regarding the relationship between proxy and direct measures (Dickinson et al., 2010), self-reporting questionnaires are prone to response and social desirability biases (Demetriou & Uzun, 2014). The use of proxy data collected via a self-report questionnaire is a common practice in behavioral research, especially when the collection and analysis using data is too time-consuming and expensive (Short, Goetzel, Pei, Tabrizi, Ozminkowski, Gibson & Wilson, 2009). Also, self-reported data cannot be subject to common method bias (Karahanna & Agarwal, 2000). As is the case in this study, collecting data at a single point in time from homogenous groups may raise concerns regarding the generalizability of its findings as respondents' perceptions about a given variable may change over time (Y. Lee et al., 2003). Furthermore, since data for the current study originated from Ethiopia, it may

prevent generalization of its findings to HE in other developing countries. However, insights gained from the study may be transferred to HE in countries that have similar contexts to Ethiopia.

11. Conclusion

This study aims at investigating the integrated causal relationship between institutional and individual level determinants and instructors' ICT use in HE in developing countries. A model was developed based on theoretical and emperical claims and validated empirically in Ethiopian HE based on survey data collected from instructors. The SEM analysis indicate that the proposed model has a good fit to the data. The finding of the study indicate that instructors' ICT competence and attitude are significant direct predictors of their ICT use, which implies that enhancing the instructors' ICT competence and attitude may result in their improved ICT use. The findings and conclusions of this study should be understood with caution for they do not mean that other institutional characteristics are not useful for instructors' ICT use. Even though they have no direct influence on ICT use, they can create a favorable environment for instructors to use ICT.

12. Future studies

The current study aids scholars by highlighting key determinants of instructors' educational use of ICT in the context of developing countries. Nevertheless, additional work is needed to ensure the robustness and cross-cultural validity of the present model. Among developing countries themselves, variations are expected in terms of geography, political, cultural, economic, social, and technological environments that have implications for ICT use in HE. It is, therefore, plausible to recommend future studies to reassess the present model in different developing countries so that a more generic and parsimonious model can be developed. Also, as evident in the current study, individual characteristics are significant predictors of instructors' ICT use. Based on this finding, one can pose such questions as 'what professional development interventions help instructors in HE in Ethiopia (and other developing countries) develop the required ICT competence and attitude to use ICT in teaching and learning?' Future research, therefore, may need to focus on designing and assessing professional development interventions that empower instructors' ICT competence and attitude in the context of HE in Ethiopia (and other developing countries). Such studies preferably implement design-based research which enables researchers to develop and test contextually-sensitive educational interventions in an authentic HE context through collaboration with instructors in an iterative manner (Wang et al., 2005). Furthermore, to

address the limitations of self-reported data, future studies need to consider the use of actual data or multiple data collection methods such as observation and time-use diaries to triangulate with self-reported data. Finally, for findings that contrast with previous studies (e.g., absence of a direct relationship between professional development and ICT competence, professional development and ICT use, support and ICT use, and infrastructure and ICT use) conducting a large scale survey and re-testing the current model in multiple sites would allow the reinforcement of a stable model of instructors' ICT use determinants. Finally, future studies are recommended to capitalize on the current finding and examine additional contextual variables to increase the model's efficiency.

Chapter Five: Determinants of Instructors' ICT Use in Higher Education: The Generic I^3 Model

Abstract

During the last decades, scholars have exerted efforts to develop models that inform the successful use of technology in higher education. Despite their contribution to understanding ICT use in different contexts, the models largely disregard the context of developing countries. The use of unproven models in higher education in developing countries may mislead ICT use practice and its impact. In this paper, a generic model, a model that is also responsive to conditions of higher education in developing countries, is presented. It is developed by integrating the findings of a mixed-method study in Ethiopia and a further review of the literature. It consists of determinants in six categories, namely: institution, instructor, student, technology, culture and academic discipline. Since the determinants in different categories are integrated in the model, it is called an integrative ICT integration model, which is also known as the I^3 model. This work can be considered as the first attempt to propose such a generic model. The proposed model may fill the gap concerning the lack of an instructors' ICT use model that may apply to HE in developing countries too. Considering that all the variables may not be equally important at different ICT use stages, a staged approach is discussed in relation the variables. It is suggested that future researches might be focused on operationalizing the determinants and their measurement as well as testing the transcultural validity of the proposed model by conducting representative studies in both developed and developing countries.

Keywords: generic model, developing countries, instructors, ICT use, higher education, the I^3 model

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1. Introduction

There is hardly an area of higher education (HE) sector that is not permeated by ICT-based activities (Liesa-oruis, Latorre-cosculluela, Sandra, & Sierra-Sánchez, 2020). One of the areas of the HE that are influenced by ICT is the teaching and learning aspect. Evidence in the literature indicates that ICT has transformed the HE landscape by enabling innovative features such as internationalization, commercialization and flexible learning (Rana et al., 2019), which are argued to be important for modern HE. Also, ICT is claimed to promote features of innovative teaching methods such as collaboration (Crook, 2011), cooperation, lifelong learning and an enabling environment for constructive learning and knowledge building (Albayrak & Yildirim, 2015). Despite the key role of ICT in transforming HE, it is yet to be an integral part of HE teaching (Gamage, 2018; Karamti, 2019) and hence the search for factors that influence successful ICT integration remains to be one area of focus in educational research.

For decades, scholars have dedicated their research to developing models and theories that inform the use and acceptance of technology (e.g., Technology Acceptance Models (Davis, 1989), and the Unified Theory of Technology Acceptance and Use (Venkatesh et al., 2003)). These models and theories have a theoretical basis and empirical validations and have been used since their inception in several technology adoption studies (including education) as the main theoretical frameworks. Despite their contribution to understanding technology adoption in different contexts, these theories have intrinsic limitations. First, the theories and models are originally developed to inform innovation adoption regardless of contexts (e.g., education, business, health etc.). For example, one of the critiques of TAM (the most widely used technology acceptance model in the study of ICT use) is that it is not envisioned to address the use of ICT in universities (Ajibade, 2019). Secondly, they are not holistic enough to capture multidimensional ICT use determinants at different levels. For example, the Roger's perceived attributes of technology only focus on attributes of innovations without considering any other psychological determinants (Faaeq et al., 2013). The other theories and models (e.g., TRA, TPB) also only focus on individual determinants (Bervell & Umar, 2017; Scherer, Siddiq, & Tondeur, 2019). Thirdly, the models have limited explanatory power. Among the notable technology acceptance models and theories, the Theory of Reasoned Action and the Unified Technology Acceptance and Use models have the lowest (36%) and the highest (70%) explanatory power, respectively (Samaradiwakara & Gunawardena, 2014; Venkatesh, Morris, Davis, & Davis, 2003). Yet, the UTAUT (that has the highest explanatory

power) is criticized by the developers themselves for its weak content validity (Venkatesh et al., 2003). Lastly, the models and theories have common limitations in that they largely disregard the socio-cultural, economic, technological and educational contexts of developing countries. As a result, the models may not be comparably used in the context of HE in developing countries as ICT use is heavily influenced by contextual differences (Lim, Chin, & Wang, 2020). A "copy and paste" approach to the adoption of western-oriented ICT use models in developing countries may lead to misleading findings. Hence, researchers need to consider developing models that suit local contexts of countries or make all the necessary adaptations before the actual adoption of the current models.

Between 2018 and 2022, a mixed-method study was conducted to develop a parsimonious ICT use model tailored to the context of HE in developing countries. This involved two research phases. First, a qualitative study was conducted in Ethiopian universities to validate ICT use determinants that were identified via a review of the literature. Complete report of the study can be found in Ferede, Elen, Van Petegem, Hunde and Goeman (2021). In the subsequent phase, a follow up quantitative investigation of the relationship between the determinants (validated via prior qualitative study) and instructors' ICT use was examined using structural equation modeling (SEM). The study's result showed that only instructors' ICT competence and attitude are direct significant predictors of their ICT use. The two determinants together explain only 35% variation in instructors' ICT use. Given the 10% threshold model explanatory power in behavioral research (Cohen, 1988), the explanatory power of the model may be sufficient. However, it is still plausible to pose the question - *Which other potential factors could explain the remaining 65% variation in the dependent variable (ICT use*)? Given the above considerations, the need for further investigation of a holistic (with additional variables) and at the same time powerful model of instructors' ICT use is crystal clear. In this paper, therefore, an integrative and generic instructors' ICT use model is proposed. In the following section, the proposed model is introduced and determinants in the model are discussed. Thereafter, the model's implementation is discussed in relation to the different ICT adoption stages. Finally, limitations of the study and direction for future studies are discussed.

2. Rationale of the model development

Because the current technology acceptance and use models neglect the context of HE in developing countries, western-oriented theories and models are used in these countries to inform ICT use practices. The use of such imported models and theories may misguide ICT

use practices and research in HE in developing countries. The proposal of the generic model may have significance in facilitating research that can indicate determinants that are important to inform instructors' ICT use practices in the context of HE in developing countries. This may enable policymakers and practitioners to make informed decisions regarding ICT use in HE. In addition, the proposed model may lead to research whose findings may push the existing knowledge horizon regarding determinants of ICT use in HE in developing countries. In sum, the proposed generic ICT use model may have contribution in addressing the gap regarding the lack of ICT model which is responsive to HE in developing countries too.

3. Method

The I^3 model is developed by integrating findings of the two empirical studies and a literature review. In the qualitative study, a thematic analysis of data collected from 21 instructors via FGD was conducted to identify determinants of instructors' ICT use. In the follow-up quantitative study, a causal relationship between the determinants and ICT use was examined using structural equation modeling (SEM) based on survey data collected from 946 instructors working in six Ethiopian universities.

Table 1

Overview of determinants in the empirical and conceptual parts

Category	Determinant	Qualitative	Quantitative	Literature
Institution	Vision and plan	✓	✓	
	Support	✓	✓	
	Infrastructure	✓	✓	
	Professional development	✓	✓	
Instructors	ICT competence	✓	✓	
	ICT attitude	✓	✓	
	Pedagogical belief			✓
Students	ICT competence	✓		✓
	ICT attitude	✓		
	Access to infrastructure	✓		
Academic discipline		✓		
Technological attributes				✓
Culture and language	Culture			✓
	Language			✓

Not all determinants supported by the qualitative evidence were included in the SEM analysis (see Table 1). Only determinants that are supported by available theoretical and empirical claims with respect to the relationship between the determinants and ICT use were included. Subsequently, a model obtained from the SEM analysis is elaborated by including determinants (a) that were identified by the qualitative study but not included in the SEM analysis (students' ICT attitude, competence and access to infrastructure and academic discipline) and (b) a further review of literature (pedagogical belief, technology attributes and culture and language) based on their strong predictive capacity as reported in the literature (the predictive capacities of these determinants are discussed in the section that follows).

4. Constituent categories and distinct factors of the model

The I^3 model is grounded on empirical proof and conceptual reasoning. The empirical part encompasses determinants that are already supported by the two prior studies whereas the conceptual part consists of new variables that are included based on reviews of the literature. Accordingly, the empirical part consists of determinants in four categories namely, institutional characteristics (ICT vision and plan, ICT support, ICT infrastructure and professional development), instructors' characteristics (ICT competence and attitude), students' characteristics (ICT access, skill and attitude) and academic discipline (course characteristics). Determinants in the institution and instructors categories resulted from the SEM analysis whereas students' characteristics and academic discipline are supported by the qualitative study. The full report of studies regarding these determinants can be found in Ferede, Elen, Van Petegem, Hunde and Goeman, (2021) and Ferede et al., (2022). The conceptual part of the model consists of variables in three categories namely; instructors' characteristics (pedagogical belief), technological attributes (relative advantage, compatibility, complexity, trialability and observability) and culture and language (see Figure 1). In discussing the I^3 model, emphasis is given to determinants that were not included in the quantitative (SEM) analysis. However, an overview of determinants that were examined in the SEM analysis is also given. For each of the new determinants, first the variable is defined and its meaning is clarified. Thereafter, the relevance of the determinant is argued based on theoretical assertions backed up by empirical claims from the literature. While conceptually some of the determinants are relevant, empirical evidence that support them is still scarce (e.g. academic discipline and perceived English language proficiency) in which case the claims heavily rely on theoretical explanations.

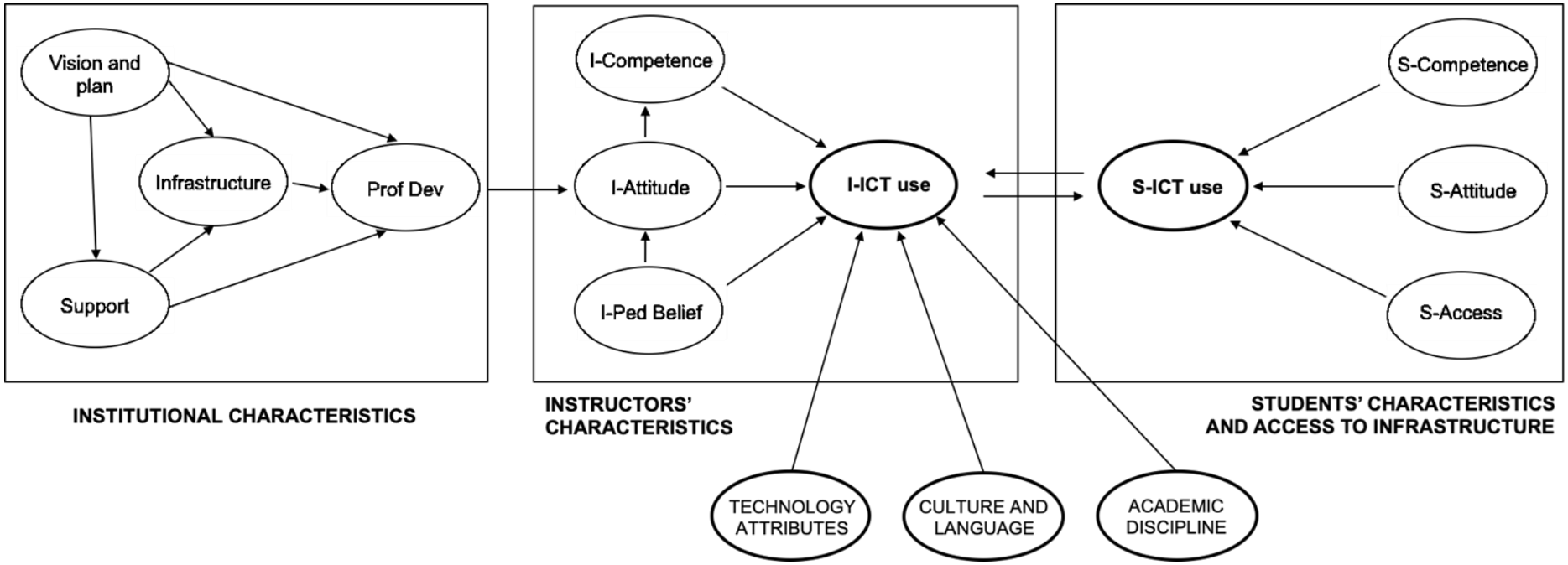

Figure 1: *The integrative ICT integration mode (the I^3 model)*

In the section that follows, the constituents of the I^3 model is discussed. The discussion starts with institutional characteristics followed by instructors' characteristics. The third section deals with students' characteristics and access to ICT infrastructure and the fourth section discusses technological attributes. Culture and language are discussed in the fifth section while discussion on academic discipline is presented in the final section.

4.1. Institutional level determinants

Institutional determinants refer to determinants that have no direct link with instructors but have systematic effect on instructors' ICT use (Ali et al., 2018).

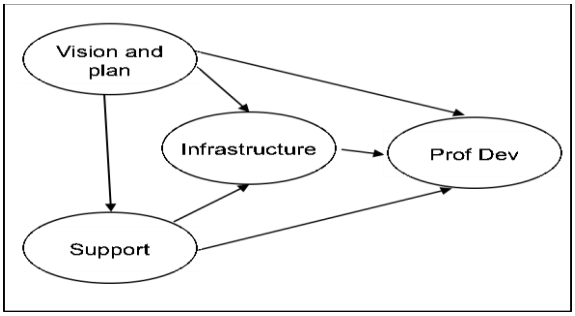

Figure 2: *Institutional characteristics*

At a university level, four variables are hypothesized as determinants of instructors' ICT use (Figure 2). These determinants are selected based on evidence from prior qualitative (Ferede et al., 2021) and quantitative (Ferede et al., 2022) studies. These determinants are;

- ✓ *ICT vision and plan:* Refers to what a university aspires to realize using ICT use, and the specification of technical and infrastructural requirements, strategies of implementation, and monitoring and evaluation techniques. ICT vision and plan have a direct influence on infrastructure, support and professional development.
- ✓ *ICT support*: Encompasses both technical (ICT technical support provided by ICT experts to instructors) and management (mainly involves funding ICT infrastructure and capacity building training necessary for ICT uptake in education. Support has a direct influence on infrastructure and professional development.
- ✓ *ICT infrastructure:* Relates to physical resources needed for ICT use. These resources include internet connectivity, ICT equipment, electricity, and classroom set-up.
- ✓ *Professional development:* Refers to capacity-building interventions organized by universities (awareness-raising, counseling, and skill development training) and

instructors' self-training (from videos and continuous ICT use practice). Professional development has a direct and indirect influence on attitude and ICT use respectively.

The finding of the prior qualitative study supported the above factors as determinants of instructors' ICT use (Ferede et al., 2021). The quantitative study, further, indicated that none of the four institutional level determinants have a direct influence on instructors' ICT use. ICT vision has a direct influence on support, infrastructure, and professional development. Support has a direct influence on infrastructure and professional development. Finally, professional development has a direct and indirect influence on ICT attitude and use respectively (see Ferede et al., 2022).

4.2. Instructors' characteristics

Instructors' characteristics refer to attributes of instructors that play a decisive role in their successful use of ICT. It encompasses ICT competence, ICT attitude and pedagogical beliefs (Figure 3).

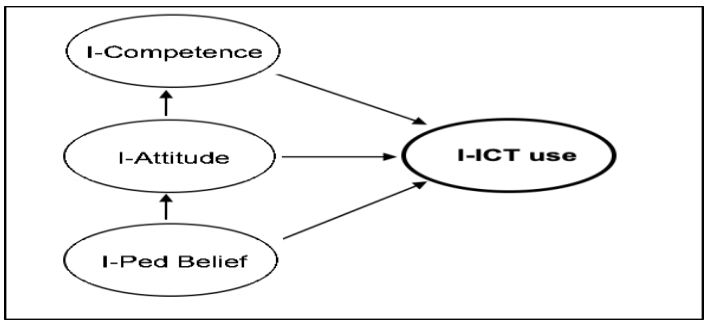

Figure 3: *Instructors' characteristics*

In the SEM analysis, two of the determinants (ICT competence and attitude) were examined in the prior studies (Ferede et al., 2022).

- ✓ *ICT competence e*ncompasses both technical ICT competence and skills needed to integrate ICT into teaching. ICT competence has a direct influence on ICT use.
- ✓ *ICT attitude refers to the i*nclination of instructors toward ICT and its use. ICT attitude has a direct influence on ICT competence and ICT use.

Since ICT competence and attitude were discussed at length in the prior studies, in this section, only instructors' pedagogical belief (new determinant) is discussed in detail.

Pedagogical beliefs

In the realm of education, belief is a difficult concept to define as the "construct educational belief itself is broad" (Pajares, 1992, P. 315). However, most authors cite the definition that belief refers to " psychological understanding, premises, or propositions perceived to be true" (Tondeur, 2020, p. 1) and pedagogical beliefs here refer to the degree to which learning technologies are aligned to instructors' understanding, premises, or propositions about teaching and learning (Ertmer, 2005).

A person's viewpoint regarding the world and one's self is shaped by the belief s/he holds to be true (Tondeur, 2020). Similarly, teachers' beliefs about teaching and learning determine their behavior (e.g., teaching method and technologies adopted) in the classroom (Pajares, 1992).

Previous studies classified pedagogical beliefs as either traditional (teacher-centered) or constructivist (student-centered) (see Deng et al., 2014). A constructivist pedagogic belief has been argued to facilitate the adoption of ICT (Sang, Valcke, Braak, & Tondeur, 2009; Zhen, Garthwait, & Pratt, 2008). An important point to note here is a teacher who holds a teacher-centered pedagogical belief in one context may have a student-centered belief in another context (Crespo, 2016). Despite its relevance, there is a dearth of scientific evidence regarding the influence of pedagogical beliefs on instructors' ICT use in the context of developing countries like Ethiopia. Historically, the Ethiopian education system has been under the influence of traditional religious education which views teachers as authorities (Shishigu, 2015). Philosophically and psychologically, the education system has been under the influence of idealism (an educational philosophy which claims that the aim of education is transmission of cultural heritage, views teachers as role models to be imitated by students and promote lecturing as teaching method) and behaviorism respectively which both promotes teacher-centered classroom education (Shishigu, 2015). The prevalent pedagogical belief (teacher-centered approach) may be a potential barrier to successful ICT use in HE in Ethiopia and other countries with a similar educational context.

The link between teachers' pedagogical belief and ICT use has not yet been extensively demonstrated. However, Knezek and Christensen (2015), in their study that adopted the extended will, skill, and tool model (WST model) of technology integration found that the inclusion of the variable "pedagogical belief" alone improved the explanatory power of the model from 60% to 90% which is quite significant. Also, in their review of academics' adoption of learning

technologies, Liu et al., (2020) claimed that teachers' pedagogical beliefs are associated with their ICT use. Instructors' pedagogical beliefs are hypothesized to have a direct influence on their ICT use (see Figure 1).

4.3. Students' characteristics and access to ICT infrastructure

The second category of determinants in the I^3model is students' characteristics and access to ICT infrastructure. In the context of the I³-model, students' characteristics refer to attributes of students that play a decisive role in their successful use of ICT (Alhabeeb & Rowley, 2017). Students' characteristics encompass three determinants, namely ICT competence, ICT attitude, and access to ICT infrastructures (Figure 4). The characteristics are relevant given the claim in the literature that in the context of education, students' ICT use behavior influences instructors' ICT use and vice versa (Bervell & Umar, 2017). Instructors can use ICT in their teaching only meaningfully when students use it. Hence, if instructors are to successfully use ICT, they need to anticipate the barriers to students' ICT use (Dhawan, 2020; Groff, 2008). Students' ICT use, in its turn, is affected by their characteristics, i.e. ICT competence, attitude, and access to ICT infrastructure. The will, skill, and tool (WST) model (Knezek & Christensen, 2015; Sasota, Cristobal, Sario, Biyo & Magadia, 2021) informs the nature of the relationship between students' ICT competence, attitude, and access to infrastructure on the one hand and ICT use on the other. The parsimonious and multidimensional WST model of technology integration showed that will (attitude towards ICT), skill (ICT competence), and tool (access to ICT) together explain 96% variation in ICT use in a study by Farjon, Smits and Voogt (2019).

Students' ICT competence

Students' ICT competence refers to students' perceived ability (knowledge and skill) to perform educational tasks using ICT (Sasota et al., 2021). ICT is argued by researchers to facilitate learning by enabling access to educational resources and by easing communication (Shatri, 2020), facilitating the development of twenty-first-century skills (see Greiff, Niepel, & Wüstenberg, 2015) and by providing alternative access to HE for students who cannot attend education on a regular schedule (Sureshbabu, 2018).

In order to benefit from the affordances of ICT, learners need ICT competences. In developing countries, students' exposure to ICT is very limited both at home and in school so that they hardly practice using ICT which may eventually result in a perceived deficiency in ICT

competence. Research evidence indicates a significant impact of perceived ICT competence on students' ICT use for educational purpose (e.g., Gasaymeh, 2018). Also, in our qualitative investigation of determinants of instructors' ICT use in Ethiopian HE, students in the studied HE institutions are reported to have limited perceived ICT competence with negative consequences on their ICT use (Ferede et al., 2021). Similarly, empirical evidence emerging currently in the context of COVID-19 indicates that students' perceived deficiency in ICT competence remains to be a critical barrier to the implementation of online learning in HE in developing countries during the pandemic (Dadhe & Kuthe, 2021; Dhawan, 2020; Olum et al., 2020). The implementation of COVID-19 induced online learning is, thus, arduous in developing countries as not all students have the required ICT competence (Adnan & Anwar, 2020; Dhawan, 2020; Ali, 2020).

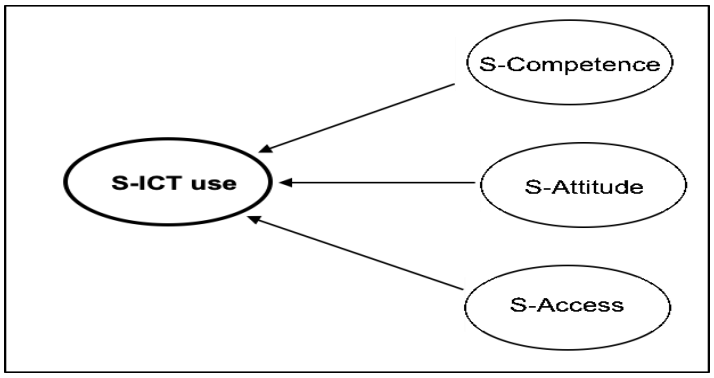

Figure 4: *Students' characteristics*

Students' ICT attitude

Students' ICT attitude refers to their predisposition to respond favorably or unfavorably to ICT use in learning (Ajzen, 1991). People successfully adopt innovations when they have a favorable attitude towards the innovation (Ajzen & Fishbein, 1980; Rogers, 1995). Specific to technology, users' (students) attitude towards ICT influences their level of ICT adoption (Bullock, 2004). As is the case for ICT competence, to benefit from what technology affords, students need to have a positive attitude towards ICT too. In developing countries, students' negative attitude is reported to be one of the critical barriers to ICT use in HE even during COVID 19 crisis (e.g., Olum et al., 2020). This negative ICT attitude of HE students in developing countries could be attributed to limited access to ICT and deficiency in ICT

competence. Having access to ICT facilitates the development of ICT skills that eventually boost ICT attitude (Klomsri & Tedre, 2016). By the same token, students with limited access to ICT infrastructure and deficiency in ICT competency may not have a good impression towards ICT so that they hardly use ICT for their learning.

Students' access to ICT infrastructure

Students' access to ICT infrastructure refers to the extent to which the internet, computers and the various applications are easy for students to access for learning purposes. Having access to ICT infrastructure is a fundamental requirement in the process of ICT use. Despite the critical role of access to ICT infrastructure, in developing countries, students rarely have access to these facilities (see e.g., Dhawan, 2020; Ferede et al., 2021; Olum et al., 2020). For the majority of the students, the cost of ICT such as internet access and device ownership is not affordable at the individual level (Dadhe & Kuthe, 2021). Although some students may have smartphones, the majority of the students have mobile phones that are not compatible with applications they need to use to perform educational tasks they are assigned to (Hrpub et al., 2020). On top of this, HEIs in developing countries are overcrowded with a large number of students which hampers the provision of ICT infrastructure to all students. Some HEIs in Ethiopia, for example, seem to made ICT infrastructure accessible to almost all their instructors but not to all their needy students (Ferede et al., 2021). As a consequence, students' educational ICT use in HE in developing countries is highly impeded.

Based on the above theoretical and empirical claims, students' ICT competence, ICT attitude and access to infrastructure are hypothesized to have a direct influence on their ICT use. An important point of consideration is students' ICT competence, attitude and access to infrastructure are interdependent and non-interchangeable. If one of the three (ICT competence or attitude or access) is missing, students ICT use will be substantially compromised. In this regard, in one of his recent publications, Elen discussed the complementarity and interaction between context (the use of mobile learning management system) and agency (the use of the system by students) (Elen, 2021). In his publication, Elen has made an interesting and topical argument about the influential role of agency, which refers to student-related factors (socio-economic, socio-cultural, and psychological) on the use of mobile learning management systems during the COVID-19 pandemic (see Elen, 2021).

4.4. Technological attributes

Attributes refer to "characteristics or qualities that describe an object or a person" (Babbie, 2013, p. 13). In this sense, perceived technological attributes relate to the characteristics or qualities of technology that determine its use as perceived by instructors. Instructors adopt ICT not only when research evidence or institutional policies encourage them to do so but also when they perceive that ICT possesses certain qualities. Elen (2021) argued the influence of context, which refers to attributes of technology (usability, usefulness, and affordability of a mobile learning management system) on technology use. Similarly, Rogers highlighted perceived technological characteristics as important determinants of the rate of adoption of an innovation (Rogers, 1995). According to Rogers, individuals or a social unit will adopt an innovation if they perceive it to have particular attributes namely, relative advantage, compatibility, complexity, trialability and observability (Rogers, 1983; Rogers, 2003). Based on Roger's (2003) definitions, the attributes are conceptually explained and empirical evidence that back the attributes is summarized in Table 2.

The concept of compatibility substantially related to two other determinants in the I^3 model. These are pedagogical beliefs and culture. Compatibility as explained above refers the degree to which ICT is perceived as in congruent with the existing sociocultural values and beliefs, past experiences, and needs of potential adopters (Al-gahtani, 2003). In this sense, the concept of compatibility relates to culture which, according to the I^3 model, refers to the alignment between ICT and cultural norms and values shared by instructors. Compatibility also conceptually overlaps with pedagogical belief as both involve the fit between ICT and instructors' belief about teaching and learning. Hence, in order to avoid unnecessary redundancy, compatibility is suggested to be excluded from attributes of technology in the I^3 model.

In short, instructors quickly adopt ICT if they perceive it to be compatible, simple, relatively advantageous, trialable and its result is demonstrable. The perceived attributes are relevant to investigate the adoption of technology in HE (Medlin, 2001; Vandover, 2013) and many studies of ICT use in the context of education adopted it as their theoretical lens (Isleem, 2003; Medlin, 2001; Wu & Sang, 2005). The five perceived technological attributes determine up to 87% of the variations in technology adoption (Ibrahim et al., 2015; Sahin, 2006). In the proposed generic model, therefore, instructors' perceptions of technological attributes are hypothesized to have a direct influence on their ICT use.

Table 2

Attributes of technology, their definition and empirical evidence

Attribute	Operational definition	Empirical evidence
Relative advantage	Instructors adopt ICT when they perceive that it has some benefits (e.g. economic, social prestige, low cost, time saving and has an immediate result) when compared to not using ICT	Jackson, Yi and Park, (2013); Smarkola (2007); Surry and Gustafson (1994); Tornatzky and Klein, (1982); Usluel, Aşkar and Baş, (2008).
Compatibility	Instructors use ICT when they perceive that it suits their needs, values, norms and experiences.	Liao and Lu (2008); Agarwal and Prasad, (1997), Surry and Gustafson (1994); Usluel et al., (2008).
Complexity	Instructors perceive a higher level of difficulty in using ICT when they perceive that its use demands more effort	Jackson et al., (2013); Tornatzky and Klein (1982); Usluel et al., (2008).
Trialability	Instructors may quickly adopt ICT if they can do a try-out	Agarwal and Prasad (1997); Martins, Steil and Todesco, (2004).
Observability	The degree to which the results of ICT are visible to others. The more the ICT use is visible or easy to describe its result to others, the more the instructors use it.	Buabeng-Andoh, (2012); Jackson et al., (2013); Kapoor and Williams (2014); Martins et al., (2004).

Though the perceived attributes of technology are predictors of ICT use, their weighted impact may not be alike across different contexts. For example, Albirini (2006), in his assessment of teachers' attitudes toward ICT in Syria excluded trialability based on the argument that the majority of the teachers in the study setting may not have had the opportunity to try out technologies before their introduction into schools . In addition, Rashid Al-Senaidi and Gawande (2013), studied factors affecting adoption of ICT among Omani faculty members and found that, unlike many studies conducted in western countries, trialability and observability do not significantly predict ICT use. The authors argue that one of the possible reasons for variation in predictive capacity of technological attributes could be due to difference in the nature of instructors' job, personal ability and life style (Rashid Al-Senaidi & Gawande, 2013).

4.5. Culture and language

Culture

Not surprisingly, there is no globally agreed-on single definition of culture (Al-Hujran & Al-dalahmeh, 2011). The most widely cited definition of culture, however, is given by Hofstede (Moghadam & Assar, 2008). To Hofstede, culture is ‘‘the collective programming of the mind which distinguishes the members of one human group from another” (Hofstede, 1997, p. 21). Hofstede’s definition of culture stresses that culture is shared values, norms and understanding within the society that mold members’ frame of thinking (Moghadam & Assar, 2008) and behavior (Johns et al., 2003).

In the study of innovation adoption like ICT, examining national culture is crucial due to its influence on ICT use. Sørnes, Sætre, Stephens and Browning (2004), argue that “ICTs, and the use of them, are examples of cultural artifacts or practices that can be examined as material manifestations of culture” (p. 3) which may imply that the design and use of ICT cannot be free from the influence of culture. The influence of national culture on ICT adoption has been empirically demonstrated (e.g., (Johns et al., 2003; Loch, Straub, & Kamel, 2003). Most ICTs that are being utilized globally (including in developing countries) are invented in western countries (Alnosiaan, 2018). This means that these technologies are aligned with western cultures as the characteristics of technologies are usually determined by the shared values and norms held by the designers (Damarin, 1998). Non-western countries are, therefore, required to use ICTs that is less aligned with their culture which could impede ICT use (Albirin, 2006).

Teachers may share the values of a society they belong to. In addition, teachers may bring with them the shared values of their society to the teaching and learning practices (Siakas & Mitalas, 2004). Research evidence indicate that the majority of them may prefer to use ICT which is aligned with their culture (see Albirin (2006). The cultural non-neutrality of ICT implies that the same ICT may not be adopted comparably across different cultures. Despite culture being considered as a factor that affects individuals' adoption of ICT (Al-Hujran & Al-dalahmeh, 2011), its influence on instructors’ ICT use in developing countries like Ethiopia is hardly examined.

The I^3 model proposes Hofstede's (1991) national culture model to examine the effect of national culture on instructors’ ICT use for the model (a) is comprehensive and relevant to be used in the educational context (Alnosiaan, 2018), (b) has been widely by studies pertaining to

culture and ICT (Leidner & Kayworth, 2006) and (c) the scores of most countries on dimensions of culture are available online enabling cross-cultural comparison of the adoption of ICT. Hofstede's national culture model has a great impact on the study of ICT adoption and even those who disagree with his dimensions adopt it as a model for their study (Al-Hujran & Al-dalahmeh, 2011).

According to Hofstede, culture has six dimensions: Power Distance, Individualism/Collectivism, Uncertainty Avoidance, Masculinity/Femininity, Long versus Short-term orientation, and Indulgence versus Restraint (see Hofstede, 1997). However, Long versus Short term orientation and Indulgence versus Restraint dimensions are usually excluded from the framework as Hofstede does not provide sufficient theoretical and empirical claims regarding the influence of the two dimensions on education (Alnosiaan, 2018).Thus, in the I^3 model, only the first four dimensions of national culture are recommended to be considered in the analysis of the influence of culture on instructors' ICT use. Hofstede's (1997) conceptual definitions of the four dimensions of national culture and evidence from literature are summarized in Table 3.

Table 3

Cultural dimensions, their definitions and empirical evidence

Dimensions of culture	Theoretical assertion	Empirical evidence from literature
Power distance (to the extent to which the less powerful members of a group or society accept and expect that power is unequally distributed	Members of lower power distance societies have more need for technologies and easily cope with technological changes than members of higher power distance.	Al-Hujran and Al-dalahmeh (2011),Sánchez-Franco, Martínez-López and Martín-Velicia (2009),
Individualism vs. Collectivism (the extent to which individuals are integrated into groups	ICT use is higher among members of individualistic society	Sánchez-Franco, Martínez-López and Martín-Velicia (2009)
Uncertainty Avoidance (the extent to which the members of a group or society feel threatened by unknown situations)	ICT use is higher in members of low avoidance culture	Leidner and Kayworth (2006),
Masculinity vs. Femininity (the extent to which gender roles are assigned in a culture.	ICT use is higher in feminine society	Bagchi et al. (2003), Osman and Köhler (2013)

Countries' national cultures can be characterized based on their score on the four cultural dimensions. Ethiopian national culture, for example, is characterized by a high power distance, collectivism, masculinity and high avoidance of uncertainty (Yewondwosen, 2020). In such society, teachers are viewed as authorities both in and outside classrooms (Hofstede et al., 2010)

which means that teachers are regarded as major sources of knowledge and wisdom, and the students' role is argued to be limited to a passive recipient of ready-made knowledge (Thowfeek & Jaafar, 2012). When the class is teacher-dominated, there is less space to integrate ICT (see e.g., Aoki, 2010) because one of the very rationales for introducing ICT in education is to enhance students' active participation. Moreover, as explained above in such a society, it is argued that there is hesitancy about new technologies (Hofstede et al., 2010). In short, culture may be a potential barrier to ICT adoption in HE in Ethiopia and other countries with comparable cultural contexts. In the proposed generic model, therefore, culture is assumed to directly influence instructors' ICT use.

Language

Language in the I3 model refers to proficiency in the English language. English is considered as a *de facto* language of technology (Grazzi & Vergara, 2012) and one of the globally predominant languages of the internet (Grazzi & Vergara, 2012). This dominance of the English language in ICT implies that ICT favors only the English language speakers and could be one major reason for the digital divide that has been observed globally. Hence, English language proficiency is beneficial for ICT use.

Owing to the aftermath of colonization, international languages such as English, Spanish and French are widely spoken in many African countries. However, there are still few countries that resisted colonization so that only local languages are widely spoken in these countries. Ethiopia is a good example of such countries. Except for a five-year occupation by Italy, Ethiopia has, however, never been colonized (Gerencheal, 2019) and, hence, the use of foreign languages (e.g. English) is limited to schools, NGOs, and rarely in federal offices. In countries where the English language is not well understood (except those who can adapt technology to their own local language), the use of ICT is very limited (Ali, 2011) and Ethiopia is not an exception to this.

Specific to education, there is an indication in the literature that teachers at all levels of education in Ethiopia have issues of English language proficiency (Birbirso, 2014) that may hamper their ICT use. When online content and application software is not available in a local language or it is difficult to translate to local languages (because most local languages are not standardized), instructors may be challenged in using available technological resources.

Though English language is perceived to be a barrier for people who do not speak the

language, its impact on ICT use is hardly examined empirically (Kiiski & Pohjola, 2002). In addition, in none of the existing technology acceptance theories and models, language is recognized as a determinant of ICT use. This might be because, in the countries where these models are originated, either the English language is not an issue or ICTs are already adapted to the language of the users. In non-English speaking developed countries (E.g., Belgium, France and Spain) local languages are used for ICT adoption. However, in developing countries where the English language is not widely spoken, proficiency in the language may be one of the major barriers to ICT use (Ali, 2011; Grazzi & Vergara, 2012). Therefore, it could be plausible to hypothesize instructors' English language proficiency as a potential determinant to their ICT use.

4.6. Academic discipline

Academic discipline refers to a specific area of study, a branch of knowledge recognized by a certain distinctness it reveals in its content and methodology (Yadav & Lakshmi, 1995). Academic discipline involves structuring of knowledge in which instructors are trained, socialized and carry out tasks of teaching (Beyer & Lodahl, 1976) which may imply that members of the same academic share similar tools, resources, approaches to teaching and learning (Goodson & Mangan, 1995). Biglan developed an empirical based taxonomy of academic disciplines based on three characteristics of discipline namely, (a) the degree to which a paradigm exists (hard versus soft discipline), (b) the extent to which the subject matter is practically applied (pure versus applied) and (c) involvement with living or organic matter (life versus nonlife systems) (see Biglan, 1973). Based on the above three characteristics, academic disciplines are classified into eight as

a. Hard/Non-life/pure (sciences e.g., Chemistry, Physics)
b. Hard/life/pure (e.g., Biology, Physiology etc.)
c. Soft/non-life/pure (e.g., Language, History)
d. Soft/life/pure (e.g., Sociology, Psychology)
e. Hard/non-life/applied (e.g., Engineering and Computing)
f. Hard/life/applied (Agricultural sciences, e.g. Animal Science, Horticulture)
g. Soft/non-life/applied (Business and Economics, e.g., Accounting, Economics)
h. Soft/life/applied (e.g., Education)

Some academic disciplines are argued to have a higher level of congruence with ICT than others (Selwyn, 1999) and instructors may resist ICT use when it is at an odd with the

characteristics of the course they teach (Goodson & Mangan, 1995). Language is mentioned in the literature to be a good example of academic disciplines that hardly lend themselves to ICT use. In this regard Andrews (2000), argues that "the subversive, humanities-based, liberal and book-dominated culture of English is undoubtedly a factor in the resistance of English teachers to new technologies" (p.23). However, such arguments need to be comprehended with caution (reconsidered based on further studies) for ICT use is not uncommon in some language classes (e.g., linguistic labs) as well. Also, such studies need to rule out if other factors such as availability of ICT infrastructure, instructors ICT competence are not reasons for ICT use variation between academic disciplines. On the other hand, science courses are argued to be ICT friendly and that they have been one of the academic domains in which ICT is used for the first time (John, 2004).

Studies indicate variations in the level of ICT use across academic disciplines. The majority of research evidence consistently supports the claim that ICTs are perceived to be more suitable for SEM courses than social sciences (e.g., Hennessy, Ruthven, & Brindley, 2005; John, 2005; Zubković et al., 2017). Also, empirical studies indicate that social science and humanities teachers have concerns regarding ICT they use it less frequently in their class (e.g., Goodwyn, Adams & Clarke, 1997; John (2005). Recent studies similarly show variations among academic disciplines regarding the extent to which they build on technological affordances (e.g., Cristina & Gairin 2020; Howard, Chan & Caputi 2015; Liu, Geertshuis, and Grainger's; 2020; Mercader, Cristina & Gairin, 2020). In several of the aforementioned studies, the impact of academic discipline on instructors' ICT use is analyzed by comparing the extent to which instructors teaching different academic disciplines use ICT, i.e., the variance between disciplines is assumed to be larger than the within disciplines (see Howard, Chan, & Caputi, 2015).

The majority of the studies that examined the impact of academic discipline, on ICT were conducted in developed countries so that evidence is scarce regarding the same issue in the context of developing countries. In our qualitative study mentioned above, the instructors perceive ICT uptake to vary across various academic disciplines because of their characteristics (see Ferede, Elen, Van Petegem, Hunde, & Goeman, 2021). The instructors perceived that teaching science and engineering subjects demand profound use of ICT compared to others such as social sciences and humanities. However, such studies need to be conducted on a large scale and supported with quantitative analysis in order to arrive at more conclusive findings. Based on

the above empirical and theoretical claims, it is hypothesized that instructors' perception of academic discipline has a direct influence on their ICT use.

5. Staged approach as a consideration for the model's implementation

An important point for consideration in applying the proposed model is the alteration that it may exhibit as the HE institutions navigate through a continuum of advancement in ICT use. Many of current ICT acceptance and use models fail to recognize that HE and instructors' ICT uses advance via various levels. ICT integration is a developmental process (Peeraer & Van Petegem, 2010), and educational institutions in both developed and developing countries navigate via a series of stages to achieve transformation in education using ICT. UNESCO identified four continuum of stages as a route through which educational institutions proceed in the process of adopting ICT namely, emerging, applying, infusing, and transforming (see UNESCO, 2002). One of the critiques of UNESCO's (2000) stages of ICT adoption may be its linearity. Progression through the stages may not necessarily be linear and the attainment of one stage may not guarantee a move to the next stage (Yücel et al., 2010). A linear model is not practical in actual real-life situations (Wolff, 2008). Hence, ICT use in HE may go forth and back between the stages. Laurillard (2014), in her discussion of drivers and enablers of innovation in higher education, for example, indicated that the relative importance and influence of each of the drivers and barriers depend on what is considered as a priority or an innovation. The relevance/importance of the enablers is determined by the extent to which they support teachers to implement the innovation. Hence, the drivers and enablers have varying degree of importance based on what is intended to be achieved (Laurillard, 2014).

As depicted in Figure 5, pedagogy shifts from traditional teacher-centered instruction to a student-centered one, and ICT use changes from being aware of the benefits of ICT use to the level creative use of ICT such as developing applications for a specific course (Majumdar, 2005). Hence, the relative importance of ICT use determinants may change along the different stages though the question *what determinant is more important at which stage* is not sufficiently discussed in the available literature.

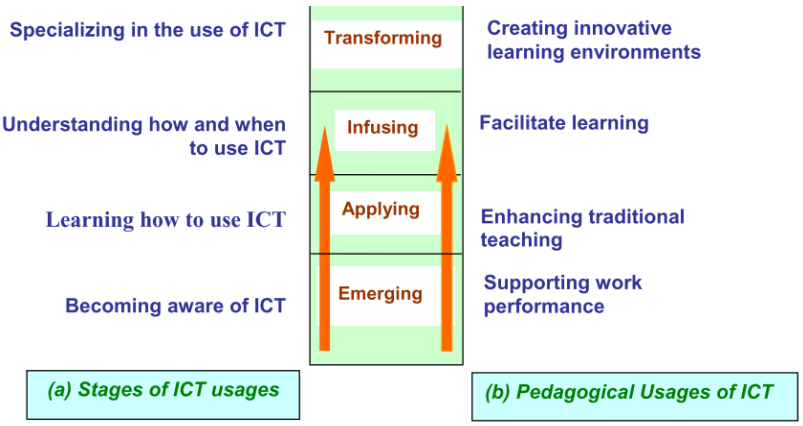

Figure 5: *Stages of ICT use in education (Majumdar, 2005).*

At an emerging stage determinants such as basic ICT infrastructure (e.g., computers), support, and instructors' basic ICT competence (UNESCO, 2002) and ICT attitude and support are critical (Yücel et al., 2010). In addition, a clear ICT policy is crucial in order to determine the type of ICT infrastructure, support and ICT competence needed at the take-off stage. Gradually, HE may reach the transforming stage where, the influence of basic ICT infrastructure, competence and attitude turns out to be minimal. Unlike in developing countries, ICT infrastructure might not be critical barriers to ICT use in developed countries which might imply that most HE in developed countries have already passed through early stages of ICT adoption.

As instructors advance to a more transformative stage, they need not only advanced ICT skills but also a pedagogical knowledge that facilitates student-centered instruction. Hence, the type of ICT competence needed by instructors may change to one that systematically integrates ICT and pedagogy. At the latest stages such as infusing and transformational, pedagogical belief rather than technical ICT competence could, thus, be a critical factor. Once, the instructors developed fundamental ICT competence at the early stage, they can update themselves with recent developments (e.g. new applications they are demanded by their institutions to adopt) with minimal support (Yücel et al., 2010). Also, as the instructors become proficient in ICT use and start to recognize its benefit, they may start to develop a positive attitude so that attitude may no more be a barrier at the later stages, i.e. infusing and transformative stages. At the later stages (e.g., when universities start hybrid teaching), a more advanced ICT infrastructure such as strong internet connectivity and applications that promote interactive and cooperative learning may be

needed. Moreover, professional development interventions that focus on enhancing instructors' innovative teaching skills (in-lieu-of basic ICT skills) may become crucial at the later stages. Furthermore, alterations in ICT infrastructure, competence and professional development at latter stages may also imply a need to adapt ICT policy to fit the specific stages.

Unlike in developed countries, student-related determinants (ICT competence and access) are currently critical determinants to instructors' ICT use in developing countries providing all students with access to ICT infrastructure may remain a difficult economic challenge for HE in developing countries. Hence, with its current status, determinants related to students are critical barriers for HE in developing countries.

Non-English speaking developing countries have two options to address language challenge in relation to ICT use. As explained earlier, in linguistically diversified non-English language speaking developing countries such as Ethiopia (where about 80 languages are spoken among more than 70 distinct ethnicities (López et al., 2021), language is a barrier to ICT use. These countries may have two options to address language barrier, i.e., either to train instructors and students to become more proficient in English language or adapt the technology to the local language. The two options are still dependent on the level of countries' economic and technological development which means that in non-English speaking developing countries, language may remain to be a determinant starting from emerging to transformative stages of ICT use for some time in the future. From the side of HE in developed countries, issues related to international students may need attention. Since the HE in developed countries enrolls a large number of international students (some from non-English or other international languages speaking countries), language could be a determinant in HE institutions in these countries too.

6. Limitations of the I^3 model and direction for future studies

The I^3 model has some limitations. All variables included in the empirical component except for ICT attitude were measured using a self-report questionnaire, i.e., using proxy measures. Self-reporting questionnaires are prone to response and social desirability (Demetriou & Uzun, 2014) and common method (Karahanna & Agarwal, 2000) biases. In addition, he newly proposed determinants are not operationalized and measurements are not yet indicated accordingly which means that the model is yet to be finished.

Another limitation is that not every relationship hypothesized in the conceptual part of the proposed model is equally supported by empirical evidence. For instance, the hypothesized

bidirectional relationships between instructors' and students' ICT use and the influence of perceived English language proficiency on ICT use are not examined sufficiently. Also, in view of holism, several determinants are proposed in the I^3 model. Although such a holistic model has an advantage of giving full picture of determinants, it may make precisions difficult. Testing of model with several variables may also make the mode testing process complex.

Finally, it is a limitation of this model that its process of testing may be costly. For example, identification of important determinants at each stage of adoption demands longitudinal study which is time and resource consuming.

7. Conclusion

In this paper, an integrative ICT integration model for instructors ICT use is in HE in developing countries is proposed. The model is proposed based on empirical evidence, theories and models from literature and taking the socio-cultural, economic and technological contexts of developing countries into account. However, it is important to highlight that the model is not yet finished to be tested empirically and inform researches and practices.

The proposed model consists of several determinants categorized under institution, instructors, students, technological attributes, culture and language, and academic discipline. By elaborating on the model of determinants, a new perspective of ICT use determinants (e.g., linkage between instructors' and students' ICT use is rarely discussed in the literature) is brought to the model in view of a holistic model with generic viability.

The staged approach to the application of the proposed model implies that HE institutions need to first assess themselves to know their whereabouts against the stages. Afterward, they may identify determinants that are decisive to move to the next stage and plan accordingly. In this regard, though it is not conclusive, many HE in developed countries seems to have passed through early stages where availability and accessibility of ICT infrastructure are barriers while those in developing countries are experiencing the take-off stage. An important note here is that HE progresses via these stages regardless of the developing and developed countries' dichotomy so that determinants in the proposed model are relevant based on where they are in the continuum of stages.

As stated earlier, the most widely adopted technology acceptance and use models may lack cross-cultural validity to be adopted in the same way in countries that have different socio-cultural contexts from the western. Developing countries, therefore, need models that take their

context into consideration. In this regard, the current (I^3) model can be taken as a pioneering framework to arrive at a model with better parsimony and generic practicability.

8. Future studies

Based on the proposed model, some avenues are indicated for future studies. Though the new determinants (the conceptual part) are proposed based on robust theoretical foundations, their relevance is not yet tested empirically. Because of additions of the new determinants to the proposed model (the conceptual part) alterations in the predicitive capacity of the individual determinant and the models' overall explanatory power (when it is tested in its totatlity) are expected. The magnitude of each of the determinants may also vary in different countries' contexts. Among developing countries themselves, contextual variations that have implications on ICT use in HE are expected. This contextual variations may imply that additional work is needed to ensure the robustness, parsimony, and cross-cultural validity of the proposed generic model. Researchers are, therfore, encouraged to test the proposed generic model in different contexts. Testing of the model involve further opertionalization of the determinants and development and validation of measurements. To ensure the applicability of the model in a broader context, future studies need to test the model based on sufficient and representative samples from both developed and developing countries. Since HEIs may not be at the same stage of ICT use and the importance of determinants may vary across the stages, future researches may consider identifying determinants that are important at each of the stages.

Finally, to address the limitations of self-reported data, future studies need to consider the use of actual data or multiple data collection methods such as observation and time-use diaries to triangulate with self-reported data.

Chapter Six: General Discussion and Conclusion

1. Introduction

This chapter of the dissertation presents a summary and an integrated discussion of the different studies and the proposed I^3 model in the light of a general discussion and conclusion. To this end, the chapter starts by presenting a brief introduction followed by discussion regarding motivation for the research. Following the motivation, the research methods are discussed. Afterwards, summaries of the three studies that resulted from the three research questions namely, (a) How do instructors in HE in Ethiopia use ICT for educational purposes? (b) What do instructors in HE in Ethiopia perceive to determine their ICT use? (c) Which perceived factors predict instructors' educational use of ICT significantly? and the I^3 model are presented. The general discussion, educational and practical implications are presented in sections five, six and seven respectively. Finally the strengths and limitations of the study as well as conclusions and trajectories for future studies are discussed.

2. Background of the study

ICT has become one of the critical pillars in the educational reform agenda of many countries- be it developed or developing (Peeraer & Van Petegem, 2011). ICT has attracted the attention of the countries because of its critical role in improving and sustaining the education sector in general and HE in particular. In this era of digitalization and globalization, HE institutions are required to meet the increasing and diversified needs of students and employers. The need by clients for affordable and accessible quality HE with optimal use of limited resources has created a fierce competition among HE institutions. If these institutions are to survive this competition, the integration of ICT would be not a matter of choice for them (James & Hopkinson, 2009). More recently, the COVID-19 crisis fortified the unique role of ICT in enabling alternative means of teaching and learning in HE (Kang, 2021) when the conventional face-to-face instruction has become challenging due to the contagious nature of the infection: It is not difficult for one to imagine what would happen to HE, the sector that is expected to play the lion's share in advancing the socio-economic and technological development of nations via education, training, and community service, in the absence of ICT. Given we are experiencing another wave of the pandemic, no one can be certain about the future of HE with COVID 19. ICT could remain the defining feature of the education sector in general and HE in particular.

3. Motivation for the study

Cognizant of the potential of ICT in improving HE, nations (developed and developing ones) have been showing greater interest and increased their investment in ICT in the last decades. Investment in ICT has been increased at both national and institutional levels (Basri et al., 2018). However, globally, there is a prevalent concern for the low impact of ICT on education compared to other sectors (e.g., Business) (Parvin, 2013) which could be due to the fact that ICT is underutilized in HE. In order to improve the use of ICT in education, researchers have developed several ICT use theories and models. However, the available ICT use models are developed mainly to inform ICT use in the context of HE in developed countries neglecting the developing countries context. As a result, in developing countries, ICT use is mostly informed by theories and models that are hardly context-driven (Kundi et al., 2010). As discussed in the introduction section of this study, there are contextual differences between developed and developing countries so that ICT use model or theory that is effective in developed countries may not be necessarily effective in developing countries. In other words western-oriented ICT models may not be adequate to explain ICT use in developing countries due to the differential contexts. If improved ICT use is to be achieved in developing countries, it needs to be informed by context-driven models. Motivated by the lack of ICT use model in developing countries, the current research aims at developing a context-driven, generic, and parsimonious ICT use model that informs HE instructors' ICT use in developing countries as well. In this study, Ethiopia is considered as an example of a developing country and evidence is generated from its HE system.

4. The research method

To achieve its objectives, the research adopted a method that consists of two (qualitative and quantitative) strands. Firstly, the study explored the perceptions of instructors in view of not only validating a literature-based conceptual framework but also elaborating the model obtained based on the quantitative analysis. The qualitative data were collected from instructors in three different Ethiopian universities using FGD and thematically analyzed using ATLAS Ti software. Through the qualitative study, variables that are worth considering in the context of Ethiopian HE were identified. Secondly, the quantitative study was undertaken to test the predictive capacity of each of the determinants and explanatory power of the hypothesized research model. The quantitative data were collected from a large cohort of instructors (946) in six universities using a survey adapted from literature using expert review. The data were analyzed using SEM.

5. Summary of the Studies

Study one: The state of the art of instructors' ICT use in Ethiopian HE

The first problem that was investigated in this study was an exploration of instructors' perceptions about their educational ICT use. Even though research evidence reported various typologies of ICT use (Meneses, Fàbregues, Rodríguez-Gómez, & Ion, 2012; Tondeur, Braak, & Valcke, 2007) it was not clear at the beginning of this study as to how instructors in HE in Ethiopia use ICT. It was, thus, reasonable to start the research by exploring instructors' ICT use. This exploration enabled to conceptualize ICT use, which is at the core of this research in a contextually valid manner. This study adopted a qualitative approach, collecting qualitative data from twenty-one by then active instructors in three public universities in Ethiopia using focus groups to explore their educational use of ICT. The data were transcribed verbatim and analyzed thematically using Atlas.ti software. The results indicate that instructors in the universities under scrutiny use ICT for course facilitation, course materials preparation, professional development, assessment, and information and resource exchange purposes. This means that instructors use ICT for a wide range of professional (teaching and learning) activities that cover supportive, classroom and managerial uses. Even though instructors in Ethiopian HE use ICT for a variety of educational purposes, its use rarely has more than a superficial impact on the quality of education. The well-established teacher-centered instruction is not transformed as a result of ICT use.

Study two: Instructors perceptions about determinants of their ICT use

The second study aimed at validating a framework of instructors' ICT use (developed based on a review of empirical and theoretical claims in scientific literature) in the context of Ethiopia. The purpose of validating the initial framework on a qualitative base was to propose a realistic model to be tested quantitatively in the subsequent study (study three). As stated earlier the initial model consists of institutional (ICT vision and plan, professional development, infrastructure, and technical support) and individual (instructors' ICT competence and ICT attitude) level determinants. The study adopted a method essentially similar to the first study except that the thematic analysis was conducted inductively vis-a-vis the pre-specified framework as well as deductively to capture themes that emerge outside the framework. The results confirmed that the institutional (ICT vision and plan, professional development,

infrastructure, and support) and individual (instructors' ICT use attitude and competence) determinants of the framework are perceived by instructors to be relevant in determining their ICT use. Moreover, management support, course-related factors, students' ICT competence and access to ICT infrastructure emerged from the analysis which implies the need to extend the initial model.

Study three: Predictive capacity of the determinants

The aim of the third study was to examine the causal relationship between ICT use and the determinants. To achieve this objective, first, a model was developed that consists of a set of hypotheses (fourteen hypotheses) regarding the relationships between institutional and individual determinants (which were identified via review of the literature and supported by the qualitative data analysis) and instructors' ICT use. The study adopted a large-scale quantitative survey in which 946 instructors who were randomly selected from six Ethiopian public universities participated. The data were analyzed using SEM and the result indicated that solely ICT competence and attitude have a direct significant influence on instructors' ICT use. The study did not find support for the hypothesized direct impacts of institutional level determinants on ICT use. The two variables (ICT attitude and competence) only explain 35% of the variation in the dependent variable.

The I^3 model

The I^3 model is proposed in response to the limited explanatory of the mode tested in study three and the inherent limitation of the current ICT use models and theories. During the last decades, efforts have been invested by scholars to develop models that inform the successful adoption of technology in HE. However, the models have limitations in that they do not take into account the context of HE in developing countries. In this phase of the research, a generic model of instructors' ICT use, a model that is responsive to the context of HE in developing countries as well is proposed. The model is proposed by integrating findings of two prior studies (study two and three) and a further review of the literature. The proposed model consists of factors in six categories namely, institution, instructor, student, technology, culture and academic discipline.

6. Discussion of the major findings

ICT use in education

It is evident in this study that instructors use ICT to strengthen classroom practices which they are stuck with. This could mean that the instructors use ICT for their convenience (e.g., rushing with the use of ICT to cover bulky lessons) rather than for the sake of students' learning. This finding is consistent with findings of recent studies (from both developed and developing countries) which state that ICT is predominantly used in a manner it facilitates teacher-centered teaching. In Oman, for example, Al-Khalidi (2021), examined teachers' beliefs on technology integration into pedagogy based on the measurement of the Substitution, Augmentation, Modification, and Redefinition (SAMR) model. The study indicated that the highest frequency of technology integration is reported in the enhancement (substitution and augmentation) stage rather than in the transformation stage (modification and redefinition) which implies that ICT is rarely used to transform teaching and learning in HE. Also, Amhag, Hellström and Stigmar (2019), studied teacher educators' use of digital tools and needs for digital competence in Swedish universities and their study showed that the teacher educator even does not primarily use ICT for pedagogic purposes. Several studies similarly indicated that instructors predominantly use ICT to foster the teacher-dominated teaching practices they are familiar with (e.g., Englund, Olofsson, & Price, 2017; Marcelo & Yot-Domínguez, 2018; Marcelo, Yot- Yot-Domínguez, & Mayor, 2015). There is also evidence in the literature that a teacher-centered ICT use is more common in classrooms facilitated by experienced teachers (Englund et al., 2017) as changing the attitude of these teachers towards a more student-centered teaching approach is a challenging and multifaceted problem (Ertmer, 2005). Such a teacher-centered ICT use has a minimal contribution in equipping students with the skills necessary to build a knowledge economy (Schildkamp et al., 2020). Innovative ICT use essentially involves change in classroom practices to the one which is highly student-oriented. In a student-oriented approach, active, independent, collaborative and lifelong learning are valued and ICT has a potential in facilitating these features of learning (Wong & Li, 2008).

Instructors' ICT use results from their intentional choice to integrate ICT in their (more student-centered) teaching, Drent and Meelissen (2008), argue. This may imply that, an innovative ICT use demands a shift from the traditional to a more student-centered instructional approach (Ertmer et al., 2007). On the other way around, ICT is a tool that facilitates the shift

towards (the implementation of) a student-centered instructional approach (Wong & Li, 2008). That is why Drent and Meelissen (2008) claimed that, "changes towards a more student-centered pedagogical approach and changes towards a more innovative use of ICT often take place simultaneously and influence each other (p. 195)." The aforementioned claims might imply that achieving an innovative use of ICT is a challenging and complex process. It involves intervening in instructors' pedagogical approach and at the same time practicing the use of appropriate technologies.

Determinants of instructors' ICT use

Until this research project less was known in developing countries, particularly in Ethiopia regarding the most important factor that determines instructors' ICT use. Historically, institutional level determinants (e.g., access to ICT infrastructure) were viewed as serious obstacles to ICT use in developing countries (Tawfik & Shepherd, 2021). When the issue of ICT use is discussed in developing countries' context, what instructors and HE leaders usually justify is the shortage of ICT resources. This claim is in congruence with study findings emerging from developing countries (see Raphael & Mtebe, 2016; Bridget, 2016; Kisanga & Ireson, 2015; Ayele & Birhanie, 2018). Undeniably, there is a shortage of resources in Ethiopian HE but it does not mean that the HE institutions are bare. They, to some extent, have this infrastructure. But why has a scarcity of resources always been claimed to be an issue when the existing ones are not utilized efficiently? In view of this question, the finding of this study may contribute to the existing understanding by indicating a new perspective. It is the instructors that matters most when it comes to their ICT use (the instructors' competence and attitude are the most important determinants of their ICT use). However, one needs to be cautious with the finding of this study as it does not mean that institutional factors are not necessary at all. Although institutional factors do not directly influence ICT use, they play a significant role due to their positive influence on individual determinants (see study three). The lack of first-order barriers (e.g. lack of training and support) could exacerbate second-order barriers (e.g., ICT attitude). This claim is in congruence with Ertmer, Ottenbreit-leftwich, and York's (2007) claim that " first-order/extrinsic barriers (e.g. infrastructure) are important but not essential when it comes to ICT use. The finding of this study denotes that determinants in the RIPPLES (except learning and evaluation), the WST models are relevant for instructors' educational ICT use. However, when analyzed in an integrated manner, instructors-related determinants are the most important factors.

This means that people (in the RIPPLES model), skill and will (in the WST model), are the most potent factors that determine instructors' ICT use.

Ertmer (1999) claims that, first-order barriers (institutional barriers in the context of this study) are easy to measure and relatively easy (with compared to second-order barriers e.g. teachers' attitude towards ICT) to eliminate once the money is allocated. This claim seems to be valid for the reason that purchasing ICT infrastructure may be easier than changing the attitude and beliefs of instructors. However, over-simplification of first-order barriers (merely linking them to money) is problematic for at least two reasons. First, first-order barriers are more than those barriers that can easily be addressed if money is available. For example, professional development is critical for improving instructors' ICT competence and attitude towards ICT. However, money alone cannot guarantee effective professional development. Studies indicate that those professional development interventions that involve huge financial investment have shown not more than superficial impact (Darling-hammond et al., 2017). Second, due to economic constraints facing HE in developing countries, addressing first- order barriers is not as easy as it is in developed countries. Hence, one may argue that Ertmer's (1999) first-order barriers need to be revisited with respect to their distinctive features and sensitivity to different (countries') contexts. This may imply that the classification of ICT use barriers as first and second-order barriers may not apply comparably in different countries contexts.

In line with the finding of this study, Ertmer et al., (2007), argue that second-order barriers are strong predictors of ICT use. This argument could be valid for the reason that instructors who have a positive attitude and commitment to use ICT could bring their own ICT devices to classrooms. Instructors with a positive ICT attitude may also devise various strategies to get instructors to support their teaching with ICT. It is less likely that instructors' ICT use is challenged by lack of ICT infrastructure if they believe in the benefits of using ICT and have a positive attitude (Ertmer et al., 2007). On the other way around, instructors who do not have a favorable attitude and commitment may not use ICT despite availability of abundant ICT resources. Important point of consideration in relation to the barriers is that even if the issues of the first and second-order barriers are addressed, instructors may be reluctant to use ICT unless it fits with their pedagogical beliefs or norms (Rogers, 2003; Tawfik & Shepherd, 2021). The relationship between the determinants is, thus, multifaceted and addressing them is not a straight forward business. This finding contributes to the existing knowledge gap in scientific literature

by showing what is decisive for instructors' ICT use in the context of developing countries, which is neglected in the existing theories.

The I^3 model

The current study is not concluded by highlighting findings obtained from the empirical analysis. The I^3 model merges the RIPPLES and the WST models (which are used as a general framework for this Ph.D. research) and extends it by elaborating on new determinants from further review of the literature (study four). The majority of The RIPPLEs model components such as resources (finance), infrastructure (e.g. computers and internet), people (e.g., attitude and skills of instructors), and support are supported by both qualitative and quantitative evidence (studies two and three). No support was found for the learning and evaluation components of the RIPPLES model. In addition, the three determinants of ICT use in the WST model (attitude, competence, and infrastructure) are supported by the empirical findings of the current research. The I^3 model, therefore, considered comprehensive enough because it integrates determinants of these two before mentioned conceptual frameworks next to the new determinants. Though the efficiency of the model obtained through the SEM analysis can be considered sufficient, further work is needed to arrive at a more powerful one. A robust model may not be achieved in the one-off survey. It rather needs a developmental process. The I^3 model is proposed to serve this purpose. The I^3 model aims at proposing instructors' ICT use model responsive to HE in developing countries. The models' proposal is based on the notion that HE in developing countries have their own context so that the use of models developed in other context (did not consider its context) may result in flimsy ICT use practice. Therefore, it is plausible to propose a model that considers the actual contexts of HE in developing countries. Once the model is tested empirically, it may become one of the potential and alternative models to inform ICT use research and practices in developing countries. The model (after empirical validation) may generate evidence to address such questions as which factors are the direct significant predictors of instructors' ICT use in HE in developing countries? Testing the model may also further the existing insight with regard to the priority in which the determinants need to be addressed so that improvement in instructors' ICT use could be initiated in HE institutions. The I^3 model, therefore, could be taken as considerable contribution for ICT use literature, specifically in the area of ICT use models and theories.The proposed model lays a good ground for further discovery of a more comprehensive and robust model of instructors' ICT use that may be

applicable to developing countries. It is understandable that there is no perfect model as all models are guided by specific theory/ies and they attempt to magnify some aspects (variables) of the model while giving little attention to the others (Moksony, 2020). When testing the proposed model in different countries, the finding may bring a new perspective to the exiting knowledge horizon: To add new variables to the existing model means (a) to retest the explanatory power of the new model (with new variables) in general and (b) if any, to see changes in the predictive capacity of the existing variables due to their interaction with the new ones. Hence, alternative explanations could be ruled out due to the additional variables (Moksony, 2020). Though this model is proposed based on the Ethiopian context, it can be used as an initial model for the development of models of instructors' ICT use in different countries. The testing of the model in different contexts may ensure its cross cultural validity and advance insight with respect to what is currently known in literature regarding determinants of instructors' ICT use in HE in developing countries.

Ethiopia as a developing nation may substantially share the social, economic, cultural, technological and educational contexts of developing countries discussed in the introductory section of this research report (chapter one). Particularly, Ethiopian HE is characterized by multifaceted issues of access, relevance, equity, and quality and addressing these educational issues is set by the government to be among the priority agenda in the coming fifteen years (MOE, 2017). Though the country is among those suffering from the global digital divide and its HE operates in a technologically least developed environment, ICT is acknowledged as a decisive tool to achieve this objective (addressing educational issues). As it is the case in other developing countries, the Ethiopian HE sector may benefit much from the potential of ICT in improving the quality of education. For example, by using ICT the HE can resolve issues of educational inputs by enabling access to abundant online educational resources and promote innovative teaching method that facilitates the development of competency in students. However, despite ambitious plans and aspirations by policymakers, ICT integration is still at an infant stage in HE in the country (Alemu, 2017). The difficulty of Ethiopian HE concerning ICT integration was more evident during the first weeks of the COVID-19 outbreak. As it is revealed by the empirical analyses of this research (studies two and three), a range of factors including institutional and individual determinants contribute to the challenge that Ethiopian HE faces concerning ICT use. Also, recent studies document that the lack of research evidence in HE of

the country could be one of major reasons for the futile use of ICT (e.g., Mengistie, 2021). While examining the local context, users' views and perception and requirements (determinants) of ICT use is crucial for an informed ICT plan, in the country, there is still a scarcity of such evidence leaving ICT use a challenging activity in the HE sector. In this respect, the findings of the current study throw light on what is decisive for ICT uptake in Ethiopian HE. For example, the main findings from empirical analyses of this research indicate that instructors' ICT competence and attitude are decisive for their ICT use (study three). Also, the instructors highlighted that interventions that lead to improved ICT competence and change in attitude are vital for their ICT use (study two). Given that the PD interventions that are in place in Ethiopian HE lack the ICT component (Getenet, 2020), the findings of the current research provide evidence for the need to revisit instructors' PD in view of improving competence and attitude that fosters pedagogical integration of ICT. Integrating educational use of ICT in both pre and in-service training may have a positive impact on instructors' ICT competence and lead to improved use of ICT in Ethiopian HE.

In addition, the I^3 model could be a relevant model to explain instructors' ICT use Ethiopian context. Some of the determinants (institutional and individual characteristics) in the I^3 model are proposed based on empirical analyses of both the quantitative and qualitative data collected from instructors in Ethiopian HE which means that these determinants are germane to realizing instructors' ICT use in the Ethiopian context. Other categories of determinants in the model are proposed based on evidence from the literature and their relevance to the Ethiopian context. For example, determinants that are related to students (competence, attitude, and access to infrastructure) are something that needs serious attention if ICT needs to be integrated in the HE of the country. In Ethiopia, 85% of HE students are from rural areas where access to ICT infrastructure is very limited and the students suffer from a deficiency in their ICT competence (Belay, 2020; Mengistie, 2021). Most of the students are from families that cannot afford costs related to computers and internet connectivity (Mengistie, 2021). Also, Ethiopia, as a country whose language and culture are not significantly influenced by western culture during colonization, cultural and linguistic mismatch could be expected when English and western-oriented technologies are used in the country (study four). It is, therefore, plausible to consider cultural and linguistic alignment issues as factors that influence Ethiopian HE instructors' ICT use. Furthermore, the only one-century-old modern education in Ethiopia is highly influenced

by teaching methods in which teachers are regarded as the major sources of knowledge (Shishigu, 2015) in which case alternative means of learning such as ICT may not be encouraged or sometimes considered as a threat (ICT may substitute teachers). This widely practiced teacher-dominated teaching in Ethiopian HE could be the influence of instructors' beliefs about HE pedagogy which means that pedagogical beliefs could be a potential determinant of their ICT use. To conclude this section, the I^3 model (determinants) is grounded in the educational, cultural, and economic contexts of Ethiopia as well as empirical and theoretical claims.

Important to note is that field data were collected before the outbreak of COVID-19. Notwithstanding, insights obtained from this Ph.D. research and the I^3 model could remain to be valid even during the COVID-19 particularly in developing countries context. Quite several studies have been published in journals since the outbreak of the pandemic both in developed and developing countries indicating that ICT has become a decisive tool to sustain education when face-to-face instruction is unfeasible. The studies focus on how HE responded the COVID-19 induced remote and emergency teaching and learning using ICT, speculation of the fate of online learning in the post-pandemic and challenges encountering the new normal. There is an indication in the post-pandemic studies that in general, the shift to online learning is quicker and easier for HE in developed countries than in developing countries (Muchabaiwa & Gondo, 2022). For those HE in which change in ICT use practice is reported (due to COVID-19), the change is more quantitative (increase in the frequency of ICT use) than qualitative ICT use (e.g, Antón-Sancho & Sánchez-Calvo, 2022; Nurjaman & Sabilah, 2022; Singh, Singh, & Garg, 2022) and stressful experience for instructors due to external barriers such as limited wireless connectivity and lack of institutional technical support (Bruggeman, Garone, Struyven, Pynoo, & Tondeur, 2022). There is no evidence that the change with respect to ICT use is transformational. Few studies reported that though instructors' frequency of ICT use is increased, they (instructors) use ICT to support the traditional teacher-centered instruction in which teachers give lengthy online lectures (e.g. Belay, 2020) which is in line with the finding of the current research (study one). What is surprising is that though instructors are forced by the COVID-19 crisis to try online teaching, the majority have still the intention to return to traditional teacher-centered face-to-face instruction (Belay, 2020).

The swift change to online learning in HE in many developing countries, particularly in Africa is challenging (Tamrat & Teferra, 2020). For example, there was high interest and

pressure from the Ethiopian government side on HE to shift to online teaching during COVID-19. However, recent studies indicate that the implementation of online learning is still challenging in Ethiopian HE (Mengistie, 2020). Though there were some attempts to reach students using ICT, it can be said that HE in the country responded to the COVID-19 crisis by suspending teaching and learning (Mengistie, 2021) which may reveal the inflexibility and poor preparation of the HE in the face of the pandemic. The difficulty with Ethiopian HE going online may not be surprising for the sector had no prior experience in ICT-supported teaching and learning and insufficient preparation (Tamrat, 2021). Lack of ICT resources (Mengistie, 2020; Mengistie, 2021; Kummitha, Kolloju, Chittoor, & Madepalli, 2021), digital illiteracy (Mengistie, 2020), limited training (Kummitha et al., 2021) for both instructors and students are still among the major challenges to the implementation of the during and post-COVID-19 online learning in Ethiopian HE. Similarly, in many developing countries online learning during COVID-19 is found to be challenging due to a lack of ICT infrastructure such as computers, limited access to internet connectivity, and deficiency in both instructors' and students' ICT skills (see e.g., Mhlanga & Denhere, 2022; Schalkwyk & Cañares, 2022; Shava, 2022; Shettar, 2021). Thus, findings of the post-COVID-19 studies with respect to ICT use practice and challenges in HE considerably complement the findings of the current Ph.D. research. In addition, since a fundamental change in ICT use practice is not reported in HE in developing countries during and the post-pandemic studies, determinants that are proposed in the I^3 model seem to be valid to date.

7. Educational implications

As discussed earlier in the background part of this dissertation, using ICT in teaching and learning is a new experience for many instructors in HE in developing countries including Ethiopia. On top of this, technologies that are used in education are constantly emerging. The integration of these ICTs and new pedagogical practices demands instructors to possess new skills, knowledge, and attitude (Schildkamp et al., 2020). There are indications in literature that developing countries are moving forward to integrate ICT into their HE. For example, in Ethiopia's Digital Skills Country Acton Plan, the use of ICT is indicated as a standard for instructors' evaluation and promotion (MOSHE, 2020) which may imply that ICT competence and attitude could be key requirements to become a qualified teacher in HE. The findings of the current research also indicate that instructors' ICT attitude and competence are significant

predictors of their ICT use (study three) which may imply that in Ethiopia, instructors' educational ICT use can be improved, among several factors, by enhancing their competence and influencing their attitude. The key question here is if instructor's ICT competence and attitude are indispensable for improved ICT use, how can these competence and attitude be improved? In this respect, instructors (ICT) professional development (PD) could be an effective strategy to improve their ICT competence and attitude.

PD, directly and indirectly, influences instructors' ICT attitude and competence respectively (study three). Similarly, in study two, the need for instructors ICT (PD) was highlighted by instructors for their improved ICT competence and attitude. Studies by another researchers also show that PD interventions may have a positive impact on ICT skills (Lavonen, Juuti, Aksela, & Meisalo, 2006; Li, Yamaguchi, Sukhbaatar, & Takada, 2019; Murthy et al., 2015) and attitude (e.g., Voogt, Almekinders, Van Den Akker, & Moonen, 2005) of teachers. Specifically, ICT-supported PD has been reported by studies to have a positive impact on instructors' ICT competence. For example, Seferoglu and Celen (2020) found that teachers' self-reported ICT competence is improved after participating in online PD. Paradoxically, in study two, it was reported that the instructors rarely have access to interventions that provide them with the necessary knowledge, skill, and attitude to use ICT. Needless to say that, if instructors are not prepared to integrate ICT, the presence of ICT infrastructure alone cannot transform teaching and learning. Therefore, instructors' PD could be crucial to transforming HE using ICT as instructors' are argued to be the groups that have the greatest influence on the quality of education (Stronge, Ward, Tucker & Hindman, 2007). As stated in the discussion section, there is interdependence between technology and pedagogy. ICT integration in education is, therefore, more than mastering a technical skill. It further involves the selection of appropriate hardware and software in relation to the learning objectives and decisions regarding when to use them. The interrelatedness between ICT and pedagogy might imply that instructors' (ICT) PD needs to involve both the pedagogy and technology components (Baran, 2018). An integrated approach to PD (that integrates ICT and pedagogy) could be effective (Rhode & Krishnamurthi, 2016) as it may impact not only instructors' ICT competence and attitude but also their pedagogical beliefs (as suggested in the I^3 model). A change in pedagogical beliefs, as well as ICT attitude and competence, may facilitate a smooth transition from the traditional teacher-centered instruction to a more student-centered one (innovative ICT use). Moreover, as argued in the I^3 model,

students' ICT competence and attitude may also determine their ICT use which further influences instructors' ICT use. In this regard, instructors' PD may have a cascading effect on students' ICT skills and attitudes. If instructors are competent and have a positive attitude towards ICT, they may impact their students to use ICT. To conclude this section, instructors are key personnel behind innovative ICT use (Somekh, 2008) and hence intervening in their competence and attitude may result in a positive change in ICT use. An improvement in ICT use could further result in enhanced quality of education.

8. Practical implications and recommendations

The findings of the current research have also some practical implications. In the findings of the qualitative study, the importance of a clear ICT vision and plan is highlighted. In addition, in the quantitative analysis, the significant influence of such ICT vision and plan on professional development, support, and infrastructure is verified. These findings may have implications at national, institutional and individual levels with regard to how instructors' ICT competence and attitude could be enhanced to improve their educational ICT use.

At the national (macro) level

Since institutions (universities) may have limited capacity (finance, human resource, and structure), to introduce and ensure sustained ICT use, support from the government is decisive. In this regard, at national the level (ministry of education), developing a general ICT in education ICT policy needs to be a decisive step. The ministry of education needs to support the HE system by developing a clear, coherent and comprehensive (that considers the different contexts of the HE institutions in the country) ICT policy (Kozma & Voogt, 2003) so that the HE institutions may develop their own context-specific policy. The national educational ICT policy among others needs to center around strategies for instructors' (ICT) PD interventions. However, for this to happen, such policies need to first articulate the purpose for which ICT is demanded (Ng, Miao, & Lee, 2009) in HE. It is the purpose of the policy that informs the type of professional development needed for instructors as well as the support and infrastructure that need to be in place. It may be useful to bring to the attention of policymakers that it is a futile exercise to try to see ICT integrated into HE teaching and learning without supporting the instructors to get out of the " business as usual" approaches to teaching and learning. Though the policy needs to give emphasis on instructors' capacity building, a systemic approach to ICT

integration is recommended to obtain a better results in ICT use (Vrasidas & Glass, 2007). Therefore, the national-level policy needs to ensure alignment of factors such as financing, infrastructure, and support with instructors' PD. The policy further needs to highlight the need for strategies to provide support and basic infrastructure for students (the I^3 model) which is one of the major challenges to ICT integration in HE in poor economies. At a national level, creating an enabling policy environment, therefore, needs to be a priority if ICT is to be integrated into teaching and learning in the HE system.

At the institutional (meso) level

The finding of the current research has also implications for institutional-level interventions. Universities are institutions where the actual ICT use takes place by instructors. The universities, therefore, need to intervene in ICT use in general and instructors' PD at two levels namely, policy and implementation levels. At a meso level, developing institutional-level ICT in education policy may create an enabling environment for improved instructors' ICT use in general and their ICT competence and attitude in particular. Institutions' ICT use in education policies, sometimes known as operational plans are local policies formulated at meso level to assist institutions to realize national policies (Tondeur et al., 2008). Institutional ICT policies are, therefore, derived from national policies and at the same time consider the actual context of their respective institutions. Like national policy, institutional educational ICT use policies need to first define the very purpose of integrating ICT in teaching and learning in specific university setting. Institutional ICT policy needs to consider instructors' PD as a core area of intervention. However, the policies also indicate strategies for ICT infrastructure development and installation of support for instructors (Salik & Zhiyong, 2014) in view of fostering a supportive ICT use environment.

At the implementation level, the universities need to involve in the actual execution of policies with a focus on instructors' PD. Universities need to support instructors to develop their ICT competence and positive attitude so that improvement in the use of ICT may be achieved. In this regard, the most common strategy used by universities to impact instructors' ICT competence and attitude is instructors' PD (Martin, Wang, Budhrani, Moore, Jokiao, 2019). However, PD could not be effective without support from the universities' leadership (Dipaola & Wanger, 2018) which might imply that the leadership needs to support PD interventions by all means (e.g., funding training, purchasing the necessary technology, preparation of training

materials). University leadership also needed to create a culture where ICT use and involvement in PD are highly valued (Hallinger & Kulophas, 2020) so that instructors may be encouraged to participate. In order for this to happen, university leaders need to conceptualize PD in which ICT is an integral part (Vescio et al., 2008).

It is important for university leadership to always ensure that ICT integration issues are sufficiently addressed in institutional plans and performance reports. Supporting ICT integration activities by mobilizing alternative sources of income may also be considered by the leadership as a workable strategy. Moreover, university leadership may encourage staff by being exemplary in involved in PD and improving their ICT competence and attitude. Furthermore, the leadership needs to network with local and international institutions to promote organizational learning that gears toward ICT use. Since ICT integration is a demanding task for instructors, it may be useful to consider linking it with their tenure and promotion.

The newness of teaching experience using ICT coupled with the inadequacy of instructors' ICT competence (reported in study two) may also imply the need to install an effective and efficient technical support system for instructors. Not all instructors may undergo a pleasant experience when working with ICT gadgets. The instructors may experience technical issues often time so technical support needs to be an integral part of ICT use activities. One potential challenge with respect to technical support is the shortage of qualified ICT experts as universities' salary scheme is uncompetitive. In this regard, the universities management may consider the possibility of using willing and capable junior university instructors and senior students as technical support providers, and these may further demand working on how to compensate for the time they spent on these extra activities.

Universities are also expected to expand ICT infrastructure so that instructors and students may have improved access to exercise using ICT. Given, the vast number of students and a growing number of instructors, it may be challenging for universities to provide access to (expensive) all. In this case, universities may consider cost-effective infrastructure. For example, regardless of their limitations, the thin client computers can handle many instructional activities and can be considered as a potential alternative to the expensive conventional computers. These computers cost only 40% of the conventional personal computers (Cimen et al., 2014).

Finally, the university leadership may institutionalize the regular monitoring and evaluation with respect to the educational ICT use implementation. These may help in checking

the policy implementation regularly and take remedies in case of deviations from policy direction or unsatisfactory performance.

At the individual (micro) level

The individual level implication of the current study is that instructors need to take initiatives to update themselves with respect to their competence and attitude in order to remain competent and competitive in the new norm (ICT-supported instruction). Institutionally arranged PD initiatives could not be adequate to meet the development needs of all instructors. Instructors may have different training backgrounds and preparations so they have varying needs when it comes to PD. Hence, a one-size fits all approach to PD that are usually organized at the university level may not be effective in bringing all instructors to a comparable level of ICT competence and attitude (Opfer & Pedder, 2011). In this respect, a self-directed professional development, a form of professional development in which instructors develop and cultivate their competence and attitude independently (Zinn & Caffarella, 1999) could be a relevant strategy. A self-directed PD is known to involve life-long-learning (Murray, 2010) and allows instructors to make decisions regarding the goal of their PD and activities leading to the achievement of these goals (Villegas-Reimers, 2003). In addition, self-directed PD is argued to promote experiential (Richards & Farrell, 2006) and independent learning even in the absence of institutional support (Alshaikhi, 2020). In short, in order to cope with the fast growth of ICT tools and dynamism in pedagogical approaches as well as to satisfy their own individual PD needs, instructors' need not always wait for institutionally arranged PD. The instructors rather need to engage themselves in PD activities that can be conducted either independently or with peers. Such form of professional development (self-directed) may include journal writing, reflection, peer coaching, peer observation and team teaching (Alshaikhi, 2020). By involving in such self-initiated and individualized PD activities instructors may fill their gap with respect to their ICT competence, and attitude.

9. Strengths and limitations of the study

This study has multiple strengths. Firstly, the study employed a mixed research method. This method enabled not only to answer each of the research questions according to their nature but also in a more logical sequence. The qualitative exploration of instructors' ICT use and its determinants paved a way to position the study variables in the specific study setting. Hence, the

study variables and their conceptualization are relevant to the study setting. Secondly, recognizing the different settings of universities in different categories (established, emerging and new) and including representatives from each category in the sample enabled well-grounded generalizability of the findings to all Ethiopian public universities. The digital recording of the FGD, its verbatim transcriptions and the members-checking technique adopted to ensure credibility of the qualitative data substantially contribute to improved quality of the data and its analysis as well.

As far as the quantitative aspect of the study is concerned, adapting the survey instruments to the study setting through review by experts and checking its internal consistency via pilot testing both guarantee the validity and reliability of the quantitative component of the study. More specifically, the use of a more advanced and powerful technique of quantitative data analysis, i.e. SEM using SPSS AMOS version implies that the survey data is analyzed not only at the structural level but also at the measurement level. The confirmatory factor analysis conducted at the measurement level had an added value in that it allows purging measurement errors resulting in minimal contamination of the estimated relationships between the latent variables. In addition, the structural level analysis (path analysis) facilitated the simultaneous analysis of the complex relationships between the latent variables, which is not the case in other analysis techniques such as multiple regressions. In sum, the systematic combination of qualitative and quantitative studies and the use of the state-of-the-art data analysis technique -enabled to achieve the overall purpose of the study (to propose a generic and parsimonious HE instructors' ICT use model which is context-driven).

The proposal of the I^3 model involves going beyond the empirical analysis. It proposes additional potential determinants based on the evidence in the available literature which means that future researchers may start from a model that has both theoretical and empirical grounds. Hence, the proposal of the model could be a merit of this study as it is a critical milestone in the process of developing a more powerful and generic model of instructors' ICT use.

This study is also not without limitations. All variables except for ICT attitude were measured using a self-report questionnaire, in other words using proxy measures. Though there is no conclusive finding regarding the relationship between proxy and direct measures (Dickinson et al., 2010), self-reporting questionnaires are prone to response and social desirability biases (Demetriou & Uzun, 2014). Though the use of proxy data collected via a self-

report questionnaire is a common practice in behavioral research, especially when the collection and analysis of data is too time-consuming and expensive (Short, Goetzel, Pei, Tabrizi, Ozminkowski, Gibson & Wilson, 2009). Also, it is a limitation of self-reported data to be subject to common method bias (Karahanna & Agarwal, 2000). As it is the case in this study, collecting data at a single point in time from homogenous groups may raise a concern regarding the generalizability of its findings as respondents' perceptions about a given variable may change over time (Lee et al., 2003). Furthermore, for the reasons stated in the introductory chapter, this study considered only instructors as a source of data. However, the inclusion of perspectives of students, officials at different levels in the universities as well as at the national level (e.g., Ministry of Education) may result in a more complete picture of the state of affairs about ICT use in Ethiopia.

As it is the case in this study, collecting data at a single point in time from homogenous groups may raise a concern regarding the generalizability of its findings as respondents' perception about a given variable may change over time (Lee et al., 2003). Responses obtained from the participants through both the FGD and survey may only reflect their current feeling. For example, participants' ICT competence and attitude as well as accessibility of ICT infrastructure may improve through time so that their perception/response may change accordingly.

10. Conclusion

On the basis of the findings of the current study (see section 3), the following conclusions were drawn regarding instructors' ICT use and its determinants in developing countries.

1. Instructors in the studied universities use ICT principally to support the existing teacher-centered pedagogy rather than in a transformative way. Such a traditional ICT use may not contribute to improved quality of education as it barely facilitates students' collaboration and active engagement in their learning. The non-transformative instructors' ICT use practice may be attributed to the prevalent teacher-centered teaching practice that dominates the Ethiopian HE classes.
2. With this study, determinants of instructors' ICT use were identified. These determinants are institutional determinants (ICT vision and plan, ICT support, ICT infrastructure, and professional development), individual determinants (ICT competence and ICT attitude), students ICT competence, and access to ICT infrastructure and academic discipline. Among these factors, individual-level determinants (instructors' ICT competence and

attitude) were found to be significant predictors of instructors' ICT use. This finding may imply that instructors' ICT use may be improved by enhancing their ICT competence and attitude.

3. In order to empower instructors with ICT use competence and attitude, professional development interventions need not only to focus on technical ICT skills but also integrate constructivists learning pedagogy. Such interventions may smooth instructors' transition to a transformative ICT use practice.
4. In search of a generic and powerful model, in this study, an integrative ICT integration (I^3) model that is responsive to the context of developing countries is proposed. The I^3 model consists of several determinants categorized under institution, instructors, students, technological attributes, culture and language, and academic discipline. By building on the model of determinants (proposing new determinants that are not in the available technology acceptance and use models and theories), new viewpoints of ICT use determinants are brought in view of parsimony and generic applicability. In addition, the relationship between instructors' and students' self-report ICT use hypothesized in the I^3 model is rarely discussed in the available literature. The model is, therefore, believed to have paramount importance in filling the gap concerning the lack of generic at the same time powerful model of instructors' ICT use.
5. ICT use is context sensitive. Theories and models of ICT use are usually developed based on specific contexts so that they have a potential risk of misguiding research findings and practices when used in different settings. ICT use models and theories, therefore, need to be tested first to see if they fit to local context before they are actually used to inform practices.

In sum, this study, by adopting a mixed method and using a powerful data analysis technique (SEM analysis) investigates factors that determine instructors' ICT use in Ethiopian HE which is hardly discussed in the available literature. The study revealed that contrary to what is widely argued by policymakers and practitioners (e.g., shortage of ICT infrastructure is the major challenge due to the deprived economic condition of the country), determinants related to the instructors are more decisive when it comes to their ICT use. In addition, guided by the notions of parsimony and generic applicability, the current research proposed an ICT model that explains instructors' ICT use in the context of developing countries. The proposed I3 model can

be regarded as a novel model because of at least three reasons. First, instructors' ICT model that is tailored to the context of developing countries in general and their HE, in particular, is hardly available in the existing literature. Secondly, the fact that the model systematically integrates determinants in different categories (e.g. institutional, instructors, students, technology, Culture and language) makes it comprehensive enough compared to other models such TAM, RIPPLES, UTAUT and WST models. Thirdly, taking the specific context of HE into account, the model acknowledges the interactive effect between instructors' and students' ICT use as well as the influence of language on instructors' ICT use which is not the case in other technology use models.

11. Avenues for future studies

Based on the major findings and limitations of this study, two trajectories of research are suggested for future studies. First, since the finding of this study indicated the crucial role of instructors' ICT competence and attitude, future studies need to focus on how to improve instructors' ICT competence and influence their attitude. In this regard, as discussed in the implication for educational and practical implication sections, one potential area of research is developing a prototype that informs professional development practices of instructors. Studies that aim at developing and testing professional development prototypes should involve research designs that actively engage instructors as co-designers, partners, implementers, collaborators and beneficiaries of educational interventions. In this respect, deign-based research (also known as developmental research) may be a relevant research approach. Design-based research, situated in an authentic educational setting allows for multiple iterations of interventions to arrive at a better design, promotes partnership between researchers and instructors as collaborators, and enables the use of multiple data collection and analysis methods to assess the intervention's impact (Anderson, 2012). Design-based research is also argued to be appropriate to understand the impact of technological interventions in educational setting (Amiel & Reeves, 2008). A one-shot intervention may result in a very limited understanding of designs that involve technology and design-based research could provide a solution for this issue by allowing multiple iterations of intervention until the best prototype of instructors' (ICT) professional development is achieved (Amiel & Reeves, 2008). Researchers may adopt variants of design-based research such as co-creation (e.g., Kaminskiene, Žydžiunaite, Jurgile, & Ponomarenko, 2020) and lesson study (Hervas, 2021). Instructors may have different needs, level of ICT competence and attitude

as well as pedagogical beliefs. Also, HE institutions may be at different stages in terms of ICT infrastructures, ICT support systems, educational philosophies etc. Hence, future studies should consider the varying needs of instructors and the specific contexts of HE while developing professional development prototypes. A one-professional development prototype-fits-all approach may not be feasible.

Secondly, though the I^3 model has its foundations, it needs to be empirically tested. Scholars are encouraged to test the model in different contexts. Operationalization of the constructs, instrument selection/development and validation are among the key works. Researchers are suggested to use a more advanced statistical techniques such as structural equation modeling (SEM) for testing of the model. The use of SEM has an advantage in that it allows analysis at both measurement (enables to conduct assessment of psychometric properties of the instruments) and structural (relationships between the constructs) levels (Schumacker & Lomax, 2010; Tomarken & Waller, 2005). Also, SEM considers errors that might arise from measurement issues which is not the case in other statistical techniques such as linear regression (Schumacker & Lomax, 2010). Beyond all, the complex paths (relationships between the constructs) hypothesized in the I^3 model can be better captured using a SEM analysis (Tomarken & Waller, 2005). Moreover, in order to address the limitations of self-reported data, future studies may consider the use of actual data (for example, the instructors may keep diaries of how often and for what purpose they use ICT everyday) or multiple data collection methods (e.g., observation of instructors' ICT use in classrooms) to complement self-reported data Furthermore, as it is discussed in chapter five (the I^3 model), HEIs may be at different stages with respect to ICT use and the importance of each of the determinants may vary across the stages. Researchers are, therefore, encouraged to examine which predictor is important at which stage.

In sum, a better understanding of factors that determine ICT acceptance and adoption may result in activities that also contribute to a more advanced qualitative use of ICT in higher education all over the world.

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Appendices

Appendix A. Survey questionnaire

Research Participant Information and Consent Form

Study Title: *The Educational Use of Information and Communication Technology (ICT) in Higher Education (HE) in Developing Countries.*
Year started: *2019*
Researcher's name and Title: *Mr. Bekalu Ferede*
Department and Institution: *Center for Instructional Psychology and Technology, Faculty of Psychology and Educational Sciences KU Leuven, Belgium AND Department of Curriculum and Teacher Education, College of Education and Behavioral Sciences, Jimma University*
Contact Information: Tel=+251911748623,Email=bekaluferede.tefera@kuleuven.be
Alternative email: bekalu.ferede@ju.edu.et

Dear Instructors,

My name is Bekalu Ferede and I am currently a registered PhD student at KU Leuven and Jimma University doing my research at the Faculty of Psychology and Educational Sciences and Education and Behavioral Science respectively. The purpose of the PhD study is to investigate determinants of instructors‟ educational use of Information and Communication Technology (ICT) in Higher Education in developing countries with a focus on Ethiopian HE. To this end the study intends to test a parsimonious conceptual model for understanding Instructors' educational use of ICT and its determinants among randomly selected instructors from six Ethiopian Public Universities. You are randomly selected for this study as you are currently teaching in one of the sampled universities. The study is conducted collaboratively with KU Leuven and Jimma University.

Your participation in this preliminary research project involves completing a series of structured questions having different instructions and can take approximately 20 to 25 minutes. Your genuine participation in this study by providing responses that best represent yourself is decisive for its quality. Your engagement in this study significantly contributes to the understanding of the educational use of ICT in HE in Developing countries. Your participation is strictly voluntary. You may choose not to participate, and you may withdraw at any time during the research project. Because incomplete questionnaires will be discarded, I kindly request you to carefully read the instructions and go through all the questions in the survey and provide responses that best describe yourself.

The information you provide in the questionnaire will be treated with the utmost confidentiality, and the anonymous processing of all data is fully guaranteed. To the best of my knowledge, there are no actual or potential risks – be they physical, psychological, legal, social or otherwise – that might result from your participation in this research project; and there will be no compensation for participating. Results of the research may be published on international journals and PhD dissertation. If you have concerns or queries about this please contact the researcher: Bekalu Ferede, Tel=+251911748623, Email= bekalu.ferede@ju.edu.et

Your signature below means that you voluntarily agree to participate in this research study.

_____ _____

Signature Date

Faculty of Psychology and Educational Sciences, KU Leuven, Belgium

College of Education and Behavioral Sciences, Jimma University, Ethiopia

A self-administered instructors' questionnaire

Dear Instructor,

This questionnaire consists of a series of structured questions under different instructions. The first part deals of demographic information of the participants. The second part consists of items that measure the different constructs (Instructors' ICT use and its determinants) and rated on a five point Likert scale. The third part consists of four alternatives that might describe your beliefs and behaviors regarding the educational use of ICT. I kindly request you to read each of the instructions and respond to all the questions. You can use "x" mark to indicate your responses for items with alternative responses and briefly state your responses for the open-ended items.

Thank you for your time and willingness to participate in this PhD research project.

Note: ICT in this study refers to computer, computer applications and the internet.

Part I: Personal information

1. **University**_____
2. **Faculty/College/Institute _____**
3. **Department_____**
4. **Gender:** Male □ Female □
5. **Age (in year)**_____
6. **Educational qualification**
   - ✓ BA/BSc/MD/DVM □
   - ✓ MSc/MA □
   - ✓ PhD □
   - ✓ Others, specify_____
7. **Academic rank**
   - ✓ Graduate Assistance □
   - ✓ Assistance lecturer□
   - ✓ Lecturer □
   - ✓ Assistant Professor □
   - ✓ Associate professor □
   - ✓ Full professor □

7. **Service year in university as a lecturer/instructor (in year) _____**

Part II: Below are statements regarding the different determinants of instructors' use of ICT in teaching and learning. Please indicate the extent to which you agree with statement by circling the number corresponding your best response

1=strongly disagree, 2=Disagree, 3=Neutral, 4=Agree and 5=strongly agree

	Items	**Scales**				
	ICT vision and plan					
VP1	My university has a clear vision on the role and place of ICT in education.	1	2	3	4	5
VP2	My university's vision on the place of ICT in education is well-known by all colleagues	1	2	3	4	5
VP3	My university's vision on the place of ICT in education is acknowledged by the colleagues.	1	2	3	4	5
VP4	My university has a well-developed ICT use plan in education.	1	2	3	4	5
VP5	I know the contents of my university's ICT use plan in education.	1	2	3	4	5
VP6	The ICT policy plan of my university starts from a shared vision on 'good' education	1	2	3	4	5
VP7	My university's ICT use plan gives me concrete assistance for working with ICT in teaching and learning.	1	2	3	4	5
	Professional development					
PD1	I frequently attend on job trainings regarding the educational use of ICT	1	2	3	4	5
PD2	I frequently attend technical ICT on job training courses.	1	2	3	4	5
PD3	I try to update myself about everything that has to do with ICT in education	1	2	3	4	5
PD4	I take initiatives to learn about everything that is related to ICT in education	1	2	3	4	5
PD5	My university organizes training workshops on ICT use in education	1	2	3	4	5
PD6	Seminars on how to use ICT in education are available in my university	1	2	3	4	5
	ICT Infrastructures					
I1	There are enough computers and computer peripherals in my university to use for educational purpose	1	2	3	4	5
I2	There is a manageable number of students in the classrooms to use ICT in my university.	1	2	3	4	5
I3	There is adequate internet service in my university.	1	2	3	4	5
I4	Internet connection is fast enough to use for teaching and learning purpose in my university.	1	2	3	4	5
I5	The available computers are powerful to use for teaching and learning. Purpose.	1	2	3	4	5
I6	I have adequate access to ICT infrastructures in my university	1	2	3	4	5
I7	Students do have adequate access to ICT infrastructures to use for learning purpose.	1	2	3	4	5
I8	The architecture of classrooms is suitable enough to use ICT	1	2	3	4	5
I9	There is uninterrupted electric supply	1	2	3	4	5

	1=strongly disagree, 2=Disagree, 3=Neutral, 4=Agree and 5=strongly agree					
	ICT Support					
S1	In my university I receive enough technical support while working with ICT.	1	2	3	4	5
S2	In my university there is a clear contact person for everything that has to do with ICT use in teaching and learning	1	2	3	4	5
S3	In my University, the ICT support contact person is willing to support me in using ICT for teaching and learning purpose	1	2	3	4	5
S4	In my University, the ICT support contact person is capable to support me in solving technical problems I encounter while using ICT	1	2	3	4	5
S5	The ICT coordinator of my college/university has a clear overview of the ICT-activities performed by instructors and students	1	2	3	4	5
S6	It is clear which tasks the ICT coordinator has at my college/university	1	2	3	4	5
S7	My university management provides consistent computer hardware and software that I can use in teaching-learning activities	1	2	3	4	5
S8	My university management provides timely ICT technical support and maintenances to facilitate ICT use in teaching and learning	1	2	3	4	5
S9	My university management encourages participation in workshops, conferences and seminars related to ICT use in education.	1	2	3	4	5
S10	My university management allocates sufficient fund for purchase of ICT infrastructure.	1	2	3	4	5
S11	My university management rewards ICT use champion instructors	1	2	3	4	5
S12	My university management insists ICT use to be criteria in instructors' tenure promotion.	1	2	3	4	5
S13	Overall, my university management feels that ICTs are important for teaching and learning.	1	2	3	4	5
S14	My colleagues assist me while using ICT for teaching and learning purpose.	1	2	3	4	5
S15	My colleagues encourage me to use ICT for teaching and learning.	1	2	3	4	5
S16	My colleagues share me information and ideas about ICT use in teaching and learning.	1	2	3	4	5
	ICT use Attitude					
A1	In my opinion, my use of ICT in university teaching implies the development of new student competences.	1	2	3	4	5
A2	I feel I accomplish more tasks in my classes due to the use of ICT.	1	2	3	4	5
A3	I feel new methodological possibilities arise in my teaching and I can put teaching innovations into practice more easily due to the incorporation of ICT.	1	2	3	4	5
A4	I feel due to the incorporation of ICT in my teaching my students are more motivated to work at my subject.	1	2	3	4	5
A5	In my opinion using ICT for the administration tasks involved in my teaching (class lists, evaluation, etc.) has been a significant improvement.	1	2	3	4	5
A6	I feel Using ICT result in a higher education with a greater degree of interdisciplinarity.	1	2	3	4	5

1=strongly disagree, 2=Disagree, 3=Neutral, 4=Agree and 5=strongly agree						
A7	In my opinion using ICT in my teaching improves student evaluation.	1	2	3	4	5
A8	In my opinion using ICT facilitates university instructors' research.	1	2	3	4	5
A9	In my opinion using ICT improves and facilitates teacher–student communication.	1	2	3	4	5
A10	In my opinion using ICT saves the instructors repeating work.	1	2	3	4	5
A11	In my opinion using ICT in teaching facilitates teaching for university instructors.	1	2	3	4	5
A12	In my opinion adequate use of ICT in teaching implies professional ongoing training for instructors.	1	2	3	4	5
A13	In my opinion students evaluate my teaching more positively if I use ICT.	1	2	3	4	5
A14	In my opinion the possibilities opened up to the instructor by certain ICT compensates for the large amount of time spent in training.	1	2	3	4	5
	ICT use competence					
C1	I can solve simple technical issues on my computer.	1	2	3	4	5
C2	I can install various software and a new computer hardware or device into my computer by myself.	1	2	3	4	5
C3	My typing skills are good.	1	2	3	4	5
C4	I can resolve issues with Office software (Microsoft Office word, excel, power point presentations etc.) without assistance.	1	2	3	4	5
C5	I use online instructional materials to figure out how to use software that I wish to learn.	1	2	3	4	5
C6	I can assist somebody in resolving technical ICT problems as an expert.	1	2	3	4	5
C7	I can perform basic picture/graphic editing.	1	2	3	4	5
C8	I can find animations related to my course and deploy them.	1	2	3	4	5
C9	I can use presentations (PowerPoint) when delivering instruction in class.	1	2	3	4	5
C10	I can find videos from Internet to support course content and have my students watch them.	1	2	3	4	5
C11	I can create online personal BLOGs (i.e., blogger and word press).	1	2	3	4	5
C12	I can inform my students about computer ethics.	1	2	3	4	5
C13	I can effectively use search engines (e.g., Google, Google scholar, Yahoo, Bing, and Ask.com etc.).	1	2	3	4	5
C14	I can use social networking services (i.e., Facebook, Twitter) for educational purposes.	1	2	3	4	5
C15	I can share instructional materials that I find online (via e-mail, Dropbox, Google Drive, etc.) with my students and colleagues	1	2	3	4	5

Part III. Below are statements regarding instructors' educational use of ICT. Please, indicate the frequency of your educational use of ICT by circling the number corresponding your pest response

1. **Never, 2. Rarely, 3. Some time, 4. Often, 5. Very Often**

How often do you use ICT for the following educational tasks?

	Item					
U1	Plan classes (develop documents, presentations and exercises)	1	2	3	4	5
U2	Prepare applications or multimedia resources (audios, videos, animations) to support classroom teaching	1	2	3	4	5
U3	Maintain a repository of educational resources for my teaching.	1	2	3	4	5
U4	Collaborate with colleagues on professional matters.	1	2	3	4	5
U5	Communicate with students.	1	2	3	4	5
U6	Process students' assessment and grading	1	2	3	4	5
U7	Encourage collaborative learning in the classroom.	1	2	3	4	5
U8	As a tool for classroom demonstrations	1	2	3	4	5
U9	As a tool for instruction	1	2	3	4	5
U10	Meet students' individual differences	1	2	3	4	5

Appendix B. Focus group discussion protocol and questions

Focus group discussion protocol and questions

Study Title: Determinants of Instructors' Educational ICT use in Higher Education in Developing Countries: Evidence from Ethiopia

Year started: *2019*

Researcher's name and Title: *Mr. Bekalu Ferede Tefera*

Department and Institution: *Center for Instructional Psychology and Technology, Faculty of Psychology and Educational Sciences KU Leuven, Belgium AND Department of Curriculum and Teacher Education, College of Education and Behavioral Sciences, Jimma University*

Contact Information: Tel=+251911748623,Email=bekaluferede.tefera@kuleuven.be
Alternative email: bekalu.ferede@ju.edu.et

Purpose: The purpose of this focus group discussion (FGD) is to learn more about what determine instructors' educational ICT use in Ethiopian higher

Target population: Instructors of three public universities in Ethiopia

1. *Determining the number and duration of the focus group discussions (FGDs)*
   a. Three FGDs at three selected universities were conducted to compare and identify themes which emerge from each discussion.
   b. Focus groups run between 90 and 110 minutes.
2. *Identifying FGD participants*
   a. Six up to eight instructors participated in each group.
   b. The participants of the FGDs were homogenous groups (all the participants were instructors in Ethiopian universities and had a comparable teaching experience and academic rank), so it was assumed that they feel comfortable speaking in the group.
   c. Instructors with teaching experience of at least two years in universities and volunteer to discuss their experience of educational ICT use and its determinants were selected.
   d. Names and contact information of potential participants were secured.
   e. Place and time of the FGD were set in consultation with the participants.
   f. An invitation was sent to the participants.
3. *Introducing the FGD*

   The facilitator

   a. Was the PhD researcher
   b. Arrived before the participants.
   c. Started the FGD by providing introductory comments.
   d. Welcomed and acknowledged everyone for volunteering to participate.
   e. Introduced him-self and let the participants introduce themselves to each other.
   f. Distributed a consent form (the consent form mainly addresses the purpose of the FGD, the role of participants and ethical considerations) to all participants.
   g. Asked the participants to review, ask any questions, and then sign the consent form.

h. Made a brief overview of the study in general and the FGD in particular (the purpose is stated in the consent form as well).
i. Distributed name tags for focus groups members (Number tags were given for the participants to keep anonymity).
j. Provided basic guidelines/ground rules for the FGD (confidentiality, respect others idea, only one Speaker at a time, open discussion and active participation is important).
k. Ensured that the participants were ready for the discussion.

4. *Conducting the FGD*
   a. The discussion questions were presented in the sequence they appear in the FGD guide.
   b. The discussions were audio recorded.
   c. The facilitator took note of the discussion setting (date, place and time) and key points.
   d. The participants were probed when needed.
   e. All participants were encouraged to reflect on the discussion and it was tried to control dominance by few.
   f. Participants were not argued whatever the idea they reflected.
   g. The FGDs were not interrupted.

5. *Closing the discussion*

   The facilitator closed the discussion by thanking the participants once again for participation and providing them with his contact information in case they have any additional thoughts or comments that they would like to share.

6. *Ethical considerations*
   a. The participants had the right to refuse participation at any time
   b. The FGDs were conducted at a time and in manner that is comfortable for all participants and permitted by the respective universities
   c. No identifying information was kept in the notes or final report

FGD questions

During the FGD the instructors are invited to discuss the following major guiding questions followed by a number of probing questions based on participants' points/reflections.

1. How frequent and for what educational purposes do you use ICT?
2. What drives/motivates you to use ICT in teaching and learning?
3. How is ICT relevant to your activities (teaching and learning)?
4. What factors determine you (not) to use ICT in teaching and learning and how do these determinants affect your use of ICT?
5. What are the enablers and barriers to instructors' educational use of ICT?
6. Any points you want to add in relation to your use of ICT in teaching and learning?